Nailah Shami

From: McDonough, Christy M (Redmond) USA <Christy.McDonough@LehighHanson.com>
Sent: Monday, August 27, 2018 12:17 PM
To: Notice Of Construction
Cc: Eric Albright; Maria Zatko
Subject: Notice of Construction Application for Thermal Desorption Unit for Soil Remediation
Attachments: FINAL_CADMAN_NOC_Application_2018-08-27.pdf

Hello,

Please find a Notice of Construction application attached for the relocation and operation of a thermal desorption unit and associated equipment to the Cadman Delta Site in North Everett. The thermal desorption unit will be used to remediate contaminated soil brought to the Delta Site from other locations. A SEPA checklist is in progress and will be submitted to the City of Everett by the end of September 2018. Cadman will pay the $1,150 filing fee to PSCAA via credit card.

This application was prepared by Ramboll on behalf of Cadman. Please do not hesitate to contact Ramboll (Eric Albright or Maria Zatko) or myself with any questions regarding this application.

Ramboll has provided the air modeling files on a One Drive directory, they can be accessed using the link below:

https://secure-web.cisco.com/1S3E082Fd4zPgzdj-3PCU01u5lU1ioto6h0jplaUMn_onlcM7HOgfTG2vODnTAQARzIV88YPaqAYMOacwoP9lh9wosCcQE_OpYTquUgP20u2w8ANspVm4zRxwgheabcKNQgimBXKnRPsHasdgQNoDK_6H9udQKTIUrbYgF9-61qBD7hN3Vhd1UZP4gU_45eFCEkbKYtX7xuUa_xyfGOZDyi6jcWyElHwQa9C2SOQEz9n_kko8Ip3YQnbQFVZWtXsQW8bYoq_P2edXZPvSocWGRFeafcRkiLv7OzifXUEGhNBvLrAg_j97em-Z1QcVuduk09HigHPE4KjGAV-di9q8tQ/https%3A%2F%2Framboll-my.sharepoint.com%2F%3Au%3A%2Fp%2Fmzatko%2FEZ2FSxjVyLtNoohgQ83dVXABSCfUwRiZ2yqZUjd79gk4Mg%3Fe%3DvHBHam

If you have any troubles with the link, please reach out to Maria Zatko at Ramboll (copied here).

Sincerely,

Christy

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Prepared for:

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BergerABAM
Vancouver, Washington

August 2018

Project Number

1690008829

NOTICE OF CONSTRUCTION APPLICATION

SOIL THERMAL DESORPTION UNIT RELOCATION EVERETT, WASHINGTON

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1. INTRODUCTION

1.1 Background

Cadman Material (Cadman) owns and operates a facility located at 6300 Glenwood Avenue in Everett, Washington (hereafter, "the Glenwood Facility") that manufactures aggregates, ready mix concrete, landfill material, and performs soil remediation using a thermal desorption unit (TDU). Cadman also leases a site located at 17 E Marine View Drive in Everett, Washington known as the "Delta Site," and hereafter referred to as "the Project Site."

Cadman proposes to relocate the TDU and associated equipment from the Glenwood Facility to the Delta Site (hereafter, "the Project"). Cadman is not proposing to permanently move any other operations or equipment from the Glenwood Facility to the Project Site. The existing TDU operation at the Glenwood Facility is authorized by Puget Sound Clean Air Agency (PSCAA) Order of Approval to Construct (OAC) No. 8408, issued June 15, 2001. Following relocation, the equipment and operating conditions at the Project Site will be the same as those outlined in OAC No. 8408. The TDU consists of a 60 ton per hour (tph) rotary drum dryer, a baghouse used to reduce particulate matter (PM) emissions, and an afterburner used to eliminate volatile organic compounds (VOCs) from the exhaust.

Because the TDU and associated equipment are being relocated to a new site within PSCAA's jurisdiction, a Notice of Construction (NOC) application must be filed with PSCAA. Based on the magnitudes of the expected net changes in air pollutant emission rates associated with the proposed relocation, the Project will not be subject to the requirements of the federal Prevention of Significant Deterioration (PSD) program. BergerABAM has retained Ramboll US Corporation (Ramboll) to prepare this NOC application on behalf of Cadman.

1.2 Organization

The key components of this application are:

- A description of the Project and expected criteria and toxic air pollutant (TAP) emission rates attributable to the project,
- A discussion of potentially applicable air quality regulations,
- An analysis of the Best Available Control Technology (BACT) for criteria pollutants and TAPs (tBACT),

- An air dispersion modeling analysis to assess compliance with ambient air quality standards, and
- An assessment of ambient TAP concentration increases.

Completed standard PSCAA NOC forms are provided in Appendix A. Appendix B presents detailed emissions calculations. Technical specification data sheets and permits for the TDU unit are included as Appendix C. Air dispersion modeling files are provided in Appendix D.

1.3 Summary of Findings

The proposed Project will comply with all applicable regulations. Air dispersion modeling was used to assess compliance with ambient air quality standards and to predict ambient TAP concentration increases for comparison to screening thresholds. A BACT analysis has been developed, and proposed BACT and tBACT have been identified for the relocated TDU and associated equipment. In summary, these analyses indicated that:

- Predicted ambient criteria air pollutant concentrations attributable to the proposed TDU relocation indicate that the Project will not cause or contribute to an exceedance of any ambient air quality standards,
- Predicted ambient TAP concentrations attributable to the proposed TDU relocation indicate that regulatory screening thresholds will not be exceeded, therefore, a second tier analysis is not required, and
- The relocated equipment will employ BACT for all criteria pollutants and tBACT for TAPs.

2. PROJECT DESCRIPTION

2.1 Physical Description

The TDU and associated equipment is currently located at Cadman's existing Glenwood Facility, located at 6300 Glenwood Avenue in Everett, Washington. The Project Site, where the TDU and associated equipment are to be relocated, is located at 17 E Marine View Drive in Everett, Washington, which is roughly 15 miles northeast of the Glenwood Facility. The Project Site is composed of portions of several parcels located in Section 8, Township 29 North, Range 5 East of the Willamette Meridian at an approximate latitude of 40°00'59" North and longitude of 122°11'36" West. Figure 2-1 shows the Project Site and surrounding area.

Figure 2-1. Location of Cadman Delta Project Site

Cadman proposes to move the TDU and associated equipment from the Glenwood Facility to the Project Site during Quarter 2, 2019.

When operational at the Project Site, the TDU will process contaminated soil from a variety of locations. Trucks will deliver the contaminated soil to the Project Site and deposit it on a flat, cement surface that will be covered by a roof. The contaminated soil will be sifted using a screener to prevent large pieces of soil from entering the rotary drum. Loaders will be used to transport the sifted soil to the rotary drum feeder for processing by the TDU.

The TDU will operate continuously for up to 144 hours each week. Remediated soil will exit the rotary drum dryer onto a conveyor belt, which will deposit the soil into trucks that will transport the soil to on-site piles. The remediated soil will be rehydrated and stockpiled before being transported off-site via truck. The screener, feeder, TDU, and remediated soil piles will all be located under a common roofed structure with no walls.

The TDU consists of a rotary drum dryer with a maximum throughput of 60 tons of soil per hour that is heated by a Hauck StarJet Model SJ200 burner with a maximum heat input capacity of 37 million British thermal units per hour (MMBtu/hr). To remove PM from the TDU exhaust, air from the rotary drum dryer will be passed through a baghouse with a maximum flow rate capacity of 42,000 actual cubic feet per minute (acfm), and a maximum operating temperature of 350°F. To remove VOCs, exhaust from the baghouse will be routed to an afterburner using a sealed duct approximately 50 feet in length. The afterburner will consist of a Hauck StarJet Model SJ360 burner with a maximum heat input capacity of 70.4 MMBtu/hr. Exhaust from the TDU will be released to the atmosphere through the afterburner stack.

No physical modifications to the existing TDU are proposed, except that the TDU will now be covered by a 45-foot tall roof. The afterburner stack will extend 3 feet above the roof.

In summary, the Project consists of the relocation of a TDU with a maximum contaminated soil throughput of 60 tons/year. Contaminated soil will be fed into a rotary dryer, the exhaust from which will be passed through a baghouse, and then through an afterburner, before being released to the atmosphere through a stack.

Figure 2-2 shows the Project Site layout depicting structures, the afterburner stack location, and the Project Site property boundary. The two storage shed structures are open-sided (i.e., roofs without walls); the tops of the roofs will be 45 feet above grade.

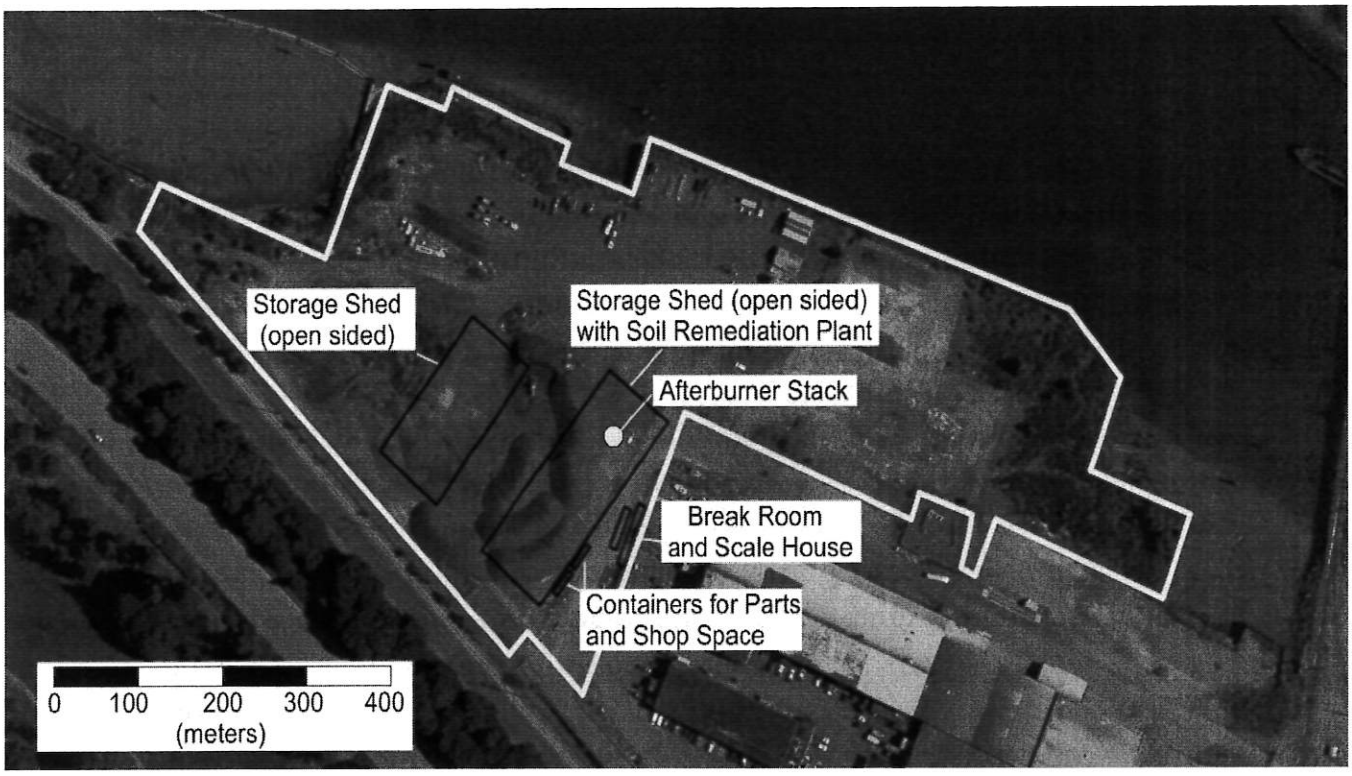

Figure 2-2. Site Layout

2.2 Project Air Pollutant Emissions

To determine the applicability of regulations, and to predict potential air quality impacts associated with the proposed project, the types and quantities of air pollutant emissions were identified. Pollutant emission rates were determined by the physical and operational characteristics of the proposed equipment.

This section describes how criteria and TAP emission rates were calculated. The TDU is expected to emit PM less than 2.5 microns in diameter ($PM_{2.5}$), PM less than 10 microns in diameter (PM_{10}), VOCs, oxides of nitrogen (NO_x), carbon monoxide (CO), sulfur dioxide (SO_2), and TAPs. Maximum potential emission rates were calculated using representative emission factors and maximum potential activity rates. Appendix B provides detailed emissions calculations.

Table 2-1 presents the maximum potential criteria pollutant emission rates associated with the Project. Table 2-2 presents maximum potential TAP emission rates associated with the Project. TDU emissions are a combination of emissions from processing the contaminated soil, combusting fuel in the rotary drum dryer burner, and treating the exhaust in the afterburner, all of which will be released to the atmosphere through the afterburner stack.

Additional detail regarding how the emission rates were calculated is provided in the sections that follow. As shown in Table 2-2, calculated maximum emission rates of NO_x, SO_2, 7,12-dimethylbenz(a)anthracene, arsenic, beryllium, cadmium, hexavalent chromium, cobalt, formaldehyde, hydrogen chloride, manganese, and vanadium attributable to the project exceed the applicable Small Quantity Emission Rates (SQERs) provided in WAC 173-460-150. Emission calculations for TAPs with emission rates below their respective SQER values are presented in Appendix B.

The $PM_{2.5}$ and PM_{10} emission rates provided in Table 2-1 and Table 5-1 are the sum of emissions attributable to combustion products from the burner used to heat the rotary drum dryer, from the rotary drum dryer combusting the contaminants in the treated soil, from the soil being handled by the rotary drum dryer, and from combusting volatilized VOCs in the afterburner. Although the baghouse is located downstream of the rotary drum dryer, PM emissions from combusting natural gas in the rotary drum dryer burner, and from the destruction by the rotary drum dryer of contaminants volatilized from the soil, were assumed to pass through the baghouse unabated. Baghouse emissions were based on the maximum rated exhaust dust concentration and the maximum exhaust flow rate. This approach to estimating emissions from the TDU is highly conservative, and likely overestimates actual emissions.

Table 2-1. Project Criteria Pollutant Potential Annual Emissions

Pollutant	Emission Rate (tpy)		
	Thermal Desorption Unit	Fugitives	Project Total
CO	3.97E+01	--	3.97E+01
NO_x	6.55E+01	--	6.55E+01
$PM_{2.5}$	3.26E+01	3.36E-02	3.26E+01
PM_{10}	3.26E+01	2.24E-01	3.28E+01
SO_2	9.50E+00	--	9.50E+00
VOC	4.70E+00	--	4.70E+00

Table 2-2. Project Potential Toxic Air Pollutant Emissions

Pollutant	CAS #	Avg. Period[1]	Emission Rate[2,3] (lb/averaging period)		Over SQER?
			Thermal Desorption Unit	SQER	
CO	630-08-0	1-hr	1.06E+01	5.04E+01	N
NO_x	10102-44-0	1-hr	1.74E+01	1.03E+00	Y
SO_2	7446-09-05	1-hr	2.52E+00	1.45E+00	Y
1,1,1-Trichloroethane	71-55-6	24-hr	1.96E-03	1.31E+02	N
3-Methylcholanthrene	56-49-5	year	1.42E-03	3.05E-02	N
7,12-Dimethylbenz(a)anthracene	57-97-6	year	1.27E-02	2.71E-03	Y
Arsenic	7440-38-2	year	3.58E+00	5.81E-02	Y
Benz(a)anthracene	56-55-3	year	1.18E-02	1.74E+00	N
Benzene	71-43-2	year	2.22E+00	6.62E+00	N
Benzo(a)pyrene	50-32-8	year	9.49E-04	1.74E-01	N
Benzo(b,k)fluoranthene	205-99-2	year	5.26E-03	1.74E+00	N
Beryllium	7440-41-7	year	8.16E-02	8.00E-02	Y
Cadmium	7440-43-9	year	1.90E+00	4.57E-02	Y
Chromium, hexavalent	18540-29-9	year	6.88E-01	1.28E-03	Y
Chrysene	218-01-9	year	7.60E-03	1.74E+01	N
Cobalt	7440-48-4	24-hr	5.02E-02	1.30E-02	Y
Copper	7440-50-8	1-hr	6.98E-04	2.19E-01	N
Dibenzo(a,h)anthracene	53-70-3	year	5.28E-03	1.60E-01	N
Ethylbenzene	100-41-4	year	1.65E-01	7.68E+01	N
Formaldehyde	50-00-0	year	1.45E+02	3.20E+01	Y
Hexane	110-54-3	24-hr	4.55E+00	9.20E+01	N
Hydrogen chloride	7647-01-0	24-hr	2.22E+01	1.18E+00	Y
Indo(1,2,3-cd)pyrene	193-39-5	year	6.98E-03	1.74E+00	N
Lead	7439-92-1	year	4.31E+00	1.60E+01	N
Manganese	7439-96-5	24-hr	2.58E-02	5.26E-03	Y
Mercury	7439-97-6	24-hr	1.59E-03	1.18E-02	N
Naphthalene	91-20-3	year	3.42E+00	5.64E+00	N
Phosphorus	7223-14-0	24-hr	7.85E-02	2.63E+00	N
Selenium	7782-49-2	24-hr	5.73E-03	2.63E+00	N
Toluene	108-88-3	24-hr	6.00E-02	6.57E+02	N
Vanadium	7440-62-2	24-hr	2.70E-01	2.63E-02	Y
o-Xylene	1330-20-7	24-hr	9.04E-04	2.90E+01	N

[1] The averaging period basis for each TAP is assigned in WAC 173-460-150.

[2] The values in the "SQER" column are the Small Quantity Emission Rates from WAC 173-460-150.

[3] As a conservative approach, uncontrolled VOC TAP emission rates from TDU are used.

2.2.1 Contaminated Soil

Cadman expects to use the proposed TDU to process contaminated soil that contains a mixture of gasoline, diesel, and heavy oil. As a conservative approach,

AP-42 emission factors for fuel oil combustion[1] by distillate oil-fired boilers rated less than 100 MMBtu/hr were used to estimate criteria pollutant emissions. AP-42 emission factors for fuel oil combustion by residual oil-fired boilers were used to estimate TAP emissions. Fuel oil contains heavier hydrocarbons, combusts less readily, and generally contains more impurities than either gasoline or diesel.

Additionally, it was assumed that contaminated soil will be subject to saltwater intrusion and, as a result, will contain sodium chloride (NaCl). To estimate chlorine concentrations in contaminated soil, a methodology used by TDUs previously permitted by PSCAA was employed (see Iron Mountain Quarry LCC, NOC No. 10707, PSCAA Worksheet). Chlorine from salt in the soil may be emitted as hydrogen chloride (HCl), and theoretical maximums were used to conservatively estimate that exhaust gases may contain up to 30 ppm dry volumetric HCl.

The presence of chloride was assumed to not result in dioxin and furan formation, based on expected project temperature ranges. If dioxins and furans were to form in the rotary drum dryer, which, as stated above, is not expected, it was further assumed that they would be combusted and destroyed by the afterburner, and that any secondary formation of dioxin and furans would be minimal due to the rapid cooling and lack of catalytic metals in the exhaust gas.

The emission factors and calculated emission rates for criteria pollutants and TAPs emitted from the contaminated soil during treatment in the rotary drum dryer are presented in Table 2-3 and Table 2-4, respectively. The TAPs included are those with emission rates greater than the SQER values listed in WAC 183-460-150. For all pollutants, annual emission rates are based on 7,509 hours per year of operation (365 days per year / 7 days per week * 144 hours per week).

[1] https://www3.epa.gov/ttnchie1/ap42/ch01/final/c01s03.pdf

Table 2-3. Contaminated Soil Emission Factors

Pollutant[1]	Emission Factor ($lb/10^3$ gal)
CO	5.00E+00
NO_x	2.00E+01
$PM_{2.5}$	2.00E+00
PM_{10}	2.00E+00
SO_2[2]	1.42E+02*S
VOC[3]	--
Arsenic	1.32E-03
Beryllium	2.78E-05
Cadmium	3.98E-04
Chromium, hexavalent	2.48E-04
Cobalt	6.02E-03
Formaldehyde	3.30E-02
Hydrogen Chloride[4]	--
Manganese	3.00E-03
Vanadium	3.18E-02

[1]AP-42, Section 1.3 Fuel Oil Combustion Emission Factors used. For criteria pollutants, distillate oil-fired EFs for boilers < 100 MMBtu/hr in Table 1.3-1 are used. For TAPs, residual oil-fired boiler EFs in Table 1.3-9 and Table 1.3-11 are used.

[2]Assumed sulfur content is 0.05% (S=0.05 in AP-42 EF formula)

[3]VOC emission rate (units: lb/hr) quantified using annual throughput (60 tons/year), maximum hydrocarbon percentage in soil (2%), assumed rotary dryer VOC destruction efficiency (75%), and assumed Afterburner VOC destruction efficiency (99.8%).

[4]Hydrogen chloride calculated assuming 30 ppm dry volumetric HCl in exhaust gas, afterburner flow rate of 5,400 standard cubic feet per minute (scfm), standard molar volume of 385 standard cubic feet per pound-mole (scf/lb-mol), and an HCl molecular weight of 36.6 pounds per pound-mole (lb/lb-mol).

AP-42 fuel oil emission factors were used for all pollutants except non-methane VOCs and hydrogen chloride (see footnotes 3 and 4 to Table 2-3). Instead, VOC emissions were calculated using maximum soil throughput (60 tons/hour) and hydrocarbon content of the soil to be treated (2 percent). Additionally, VOC destruction efficiencies for the rotary drum dryer (75 percent) and afterburner (99.8 percent) were applied. VOC destruction efficiencies for the rotary drum dryer and afterburner are not available, and were assumed to be equivalent to those of previously permitted operations using similar equipment (e.g., Iron Mountain Quarry).

Table 2-4. Contaminated Soil Emissions

Pollutant	Emission Rate[1,2] (lb/hr)	(lb/day)	(tpy)
CO	1.73E+00	4.15E+01	6.49E+00
NO_x	6.91E+00	1.66E+02	2.60E+01
$PM_{2.5}$	6.91E-01	1.66E+01	2.60E+00
PM_{10}	6.91E-01	1.66E+01	2.60E+00
SO_2	2.45E+00	5.89E+01	9.21E+00
VOC	1.20E+00	2.88E+01	4.51E+00
Arsenic	4.56E-04	1.10E-02	1.71E-03
Beryllium	9.61E-06	2.31E-04	3.61E-05
Cadmium	1.38E-04	3.30E-03	5.17E-04
Chromium, hexavalent	8.57E-05	2.06E-03	3.22E-04
Cobalt	2.08E-03	4.99E-02	7.81E-03
Formaldehyde	1.14E-02	2.74E-01	4.28E-02
Hydrogen Chloride	9.24E-01	2.22E+01	3.47E+00
Manganese	1.04E-03	2.49E-02	3.89E-03
Vanadium	1.10E-02	2.64E-01	4.13E-02

[1]Daily emission rates based on the hourly emission rate operating 24 hours per day. Annual emissions based on 7,509 hours of operation per year.

[2]Uncontrolled VOC TAP emission rates from TDU are presented above.

2.2.2 Burners

The rotary drum dryer burner is a Hauck StarJet Model SJ200 open-fire, multi-fuel burner, equipped with 36 ounces per square inch gauge (osig) direct drive blowers. It has a maximum heat input capacity of 37 MMBtu/hr, and a maximum exhaust flow rate of 2,800 scfm, which is equivalent to 33,480 acfm at 550°F[2]. The rotary drum dryer will be operated at 550°F. The afterburner is a Hauck StarJet open-fire, multi-fuel burner (Model SJ360 with 36 osig direct drive blowers) with a maximum capacity of 70.4 MMBtu/hr and a maximum exhaust flow rate of 5,400 scfm, which is equivalent to 125,322 acfm at 1,500°F[2]. The afterburner will be operational only after its temperature reaches 1,400°F. The afterburner stack is rectangular with cross-sectional dimensions of 50 inches by 81 inches. The stack exhaust point is 48 feet above grade.

The burners will operate continuously for up to 144 hours each week. Manufacturer and model information for the rotary drum dryer and the afterburner are not

[2] http://pdf.directindustry.com/pdf/hauck/starjet/21960-389629-_6.html

known. As mentioned in Section 2.2.1., it is assumed that the VOC destruction efficiency is 75 percent for the rotary dryer and 99.8 percent for the afterburner.

Table 2-5 presents AP-42 Natural Gas Combustion emission factors[3] used for the rotary drum dryer burner and the afterburner. Table 2-6 and Table 2-7 show emission rates for the rotary drum dryer burner and afterburner, respectively. Emission factors and calculated emission rates for criteria pollutants, greenhouse gases, and TAPs emitted from the burners during natural gas combustion are presented. Only TAPs with emissions above the SQER values listed in WAC 183-460-150 are included. For all pollutants, annual emission rates are based on 7,509 hours per year of operation.

A natural gas heat content of 1,020 British thermal units per standard cubic foot (Btu/ft^3) of natural gas was used to convert the burner capacities from MMBtu/hr to million standard cubic feet of natural gas per hour (MMscf/hr). Based on a maximum capacity of 37 MMBtu/hr, the rotary dryer burner uses up to 0.036 MMscf/hr. With a maximum capacity of 70.4 MMBtu/hr, the afterburner uses up to 0.069 MMscf/hr.

There is uncertainty surrounding the AP-42 natural gas external combustion emission factor for total chromium. To obtain the hexavalent chromium emission factor for the burners, the chromium emission factor in AP-42 Section 1.4 was scaled by a total-chromium-to-hexavalent chromium emission factor (0.04) from EPA's 2011 National Emission Inventory (NEI) database.[4]

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[3] https://www3.epa.gov/ttnchie1/ap42/ch01/final/c01s04.pdf

[4] EPA, 2011 National Emissions Inventory, version 2 Technical Support Document, August 2015, page 43. Speciation factor from: ftp://ftp.epa.gov/EmisInventory/2011/doc/2011nei_supdata_chromspeciation.zip

Table 2-5. Proposed Rotary Burner and Afterburner Emission Factors	
Pollutant	**Emission Rate[1] (lb/MMscf of Natural Gas)**
CO	8.40E+01
NO_x	1.00E+02
PM_{25}	7.60E+00
PM_{10}	7.60E+00
SO_2	6.00E-01
VOC	5.50E+00
7,12-Dimethylbenz(a)anthracene	1.60E-05
Arsenic	2.00E-04
Beryllium	1.20E-05
Cadmium	1.10E-03
Chromium, hexavalent	5.60E-05
Cobalt	8.40E-05
Formaldehyde	7.50E-02
Manganese	3.80E-04
Vanadium	2.30E-03
[1]AP-42, Section 1.4 Natural Gas Combustion Emission Factors for <100 MMBtu Uncontrolled Small Boilers	

Table 2-6. Proposed Rotary Dryer Burner Emissions

Pollutant	Emission Rate[1,2] (lb/hr)	(lb/day)	(tpy)
CO	3.05E+00	7.31E+01	1.14E+01
NO_x	3.63E+00	8.71E+01	1.36E+01
$PM_{2.5}$	2.76E-01	6.62E+00	1.04E+00
PM_{10}	2.76E-01	6.62E+00	1.04E+00
SO_2	2.18E-02	5.22E-01	8.17E-02
VOC[3]	4.99E-02	1.20E+00	1.87E-01
7,12-Dimethylbenz(a)anthracene[4]	5.80E-07	1.39E-05	2.18E-06
Arsenic	7.25E-06	1.74E-04	2.72E-05
Beryllium	4.35E-07	1.04E-05	1.63E-06
Cadmium	3.99E-05	9.58E-04	1.50E-04
Chromium, hexavalent[5]	2.03E-06	4.88E-05	7.63E-06
Cobalt	3.05E-06	7.31E-05	1.14E-05
Formaldehyde[4]	2.72E-03	6.53E-02	1.02E-02
Manganese	1.38E-05	3.31E-04	5.18E-05
Vanadium	8.34E-05	2.00E-03	3.13E-04

[1]Daily emission rates based on the hourly emission rate operating 24 hours per day. Annual emissions based on 7,509 hours of operation per year.

[2]Maximum burner capacity of 37 Mbtu/hr converted to 36,275 ft^3 natural gas/hr using natural gas heat content of 1020 Btu/ft^3.

[3]VOC burner control efficiency of 75% applied to VOC emissions.

[4]In conservative approach, uncontrolled VOC TAP emission rates from TDU are used in modeling.

[5]Hexavalent chromium emission factor is based on the total chromium emission factor with a speciation factor (0.04) from EPA's 2011 National Emission Inventory.

Table 2-7. Proposed Afterburner Emissions

Pollutant	Emission Rate[1,2] (lb/hr)	(lb/day)	(tpy)
CO	5.80E+00	1.39E+02	2.18E+01
NO_x	6.90E+00	1.66E+02	2.59E+01
$PM_{2.5}$	5.25E-01	1.26E+01	1.97E+00
PM_{10}	5.25E-01	1.26E+01	1.97E+00
SO_2	4.14E-02	9.94E-01	1.55E-01
VOC[3]	7.59E-04	1.82E-02	2.85E-03
7,12-Dimethylbenz(a)anthracene[4]	1.10E-06	2.65E-05	4.15E-06
Arsenic	1.38E-05	3.31E-04	5.18E-05
Beryllium	8.28E-07	1.99E-05	3.11E-06
Cadmium	7.59E-05	1.82E-03	2.85E-04
Chromium, hexavalent[5]	3.87E-06	9.28E-05	1.45E-05
Cobalt	5.80E-06	1.39E-04	2.18E-05
Formaldehyde[4]	5.18E-03	1.24E-01	1.94E-02
Manganese	2.62E-05	6.29E-04	9.85E-05
Vanadium	1.59E-04	3.81E-03	5.96E-04

[1]Daily emission rates based on the hourly emission rate operating 24 hours per day. Annual emissions based on 7,509 hours of operation per year.

[2]Maximum burner capacity of 70.4 Mbtu/hr converted to 69,020 ft^3 natural gas/hr using natural gas heat content of 1020 Btu/ft^3.

[3]VOC burner control efficiency of 99.8% applied to VOC emissions.

[4]In conservative approach, uncontrolled VOC TAP emission rates from TDU are used in modeling.

[5]Hexavalent chromium emission factor is based on the total chromium emission factor with a speciation factor (0.04) from EPA's 2011 National Emission Inventory.

2.2.3 Rotary Drum Dryer PM Emissions

A baghouse, manufactured by Maxam Equipment, Inc. (Model: Stationary Baghouse, Size 24/14.5), will be used to reduce PM emissions from the rotary drum dryer. The baghouse has a maximum flow rate of 42,000 acfm and a maximum operating temperature of 350°F. The air-to-cloth ratio is 5.27:1, the operating pressure drop is 3 to 6 inches water gauge, the cleaning mechanism is pulse jet, and the rated PM removal efficiency is 99.7 percent. The baghouse specifications sheet provided in Appendix C contains additional information about the baghouse.

The current permit issued for the TDU at the Cadman Glenwood Facility limits total PM emissions from the TDU to 0.02 grains per dry standard cubic foot (gr/dscf), and PM emissions from the relocated TDU are based on that emission factor. All PM emissions from the baghouse were assumed to be $PM_{2.5}$, so PM, PM_{10}, and $PM_{2.5}$ emissions were assumed to all be equivalent. The baghouse will operate whenever

the TDU is operating (i.e., up to 144 hours a week, or 7,509 hours a year). Table 2-8 presents $PM_{2.5}$ and PM_{10} emissions from the baghouse.

Table 2-8. Proposed Baghouse Emissions

Pollutant	Emission Rate[1,2]		
	(lb/hr)	(lb/day)	(tpy)
$PM_{2.5}$	7.20E+00	1.73E+02	2.70E+01
PM_{10}	7.20E+00	1.73E+02	2.70E+01

[1]Emissions estimated using total PM loading (0.2 gr/dscf) and maximum flow rate of 42,000 acfm.
[2]Assumed that all PM is $PM_{2.5}$. Therefore, $PM_{2.5}$ is equal to PM_{10}.

2.2.4 Fugitive PM Emissions

As described in section 2.1, contaminated soil will be passed through a screener to remove large pieces of soil. Loaders traveling on paved surfaces will be used to move sifted soil to the rotary drum dryer feeder located approximately 40 feet from the screener. Remediated soil from the rotary drum dryer will be loaded into trucks by a conveyor belt, and the trucks will transfer the soil to on-site piles. The screener, feeder, TDU, and remediated soil piles will be located under the same roof. Fugitive PM emissions from the screener, feeder, and conveyor belt were estimated using maximum soil throughput (60 tons/hr) and AP-42 emission factors. Fugitive emissions from on-site truck operations were not quantified, as they will occur entirely on paved surfaces that will be kept clean through a sweeping and watering program.

Controlled screener emission factors from AP-42 Section 11.19.2[5] (Crushed Stone Processing and Pulverized Mineral Processing) were used to calculate PM_{10} emissions from the screening process. Controlled screener emission factors were used because the moisture content of the untreated soil is expected to be greater than 2.88 percent.[6]

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[5] https://www3.epa.gov/ttnchie1/ap42/ch11/final/c11s1902.pdf

[6] Tables 11.19.2-1 and 11.19.2-2 indicate that the material at facilities operating wet suppression systems (i.e., controlled) have moisture contents ranging from 0.55 to 2.88 percent. Table 13.2.4-1 in AP-42 Section 13.2.4 (Aggregate Handling and Storage Piles) provides a mean soil moisture content of 14 percent for "Municipal solid waste landfills – Clay/dirt mix." Because the expected moisture content of the soil is significantly greater than 2.88 percent, we believe it is appropriate to use emission factors that reflect the application of wet suppression systems.

AP-42 Section 11.19.2 does not provide $PM_{2.5}$ emission factors for controlled screening. $PM_{2.5}$ emissions from the screener were assumed to be 15 percent of PM emissions, based on information from AP-42 Appendix B.2 (Generalized Particle Size Distributions), Table B.2-2 (Description of Particle Size Categories), for mechanically-generated aggregate and unprocessed ore (Category 3, which includes emissions from milling, grinding, crushing, screening, conveying, cooling, and drying of material).[7]

Continuous drop fugitive emission factors were calculated using Equation 1 in AP-42 Section 13.2.4 (Aggregate Handling and Storage Piles) and used to estimate fugitive $PM_{2.5}$ and PM_{10} emissions from the rotary drum feeder and conveyor belt. Continuous drop emission factors are calculated using aerodynamic particle size multipliers (k) for PM_{10} (0.35) and $PM_{2.5}$ (0.053), material moisture content (14 percent based on AP-42 Table 13.2.4-1), and wind speed. The mean wind speed at Paine Field (KPAE) from 2013 through 2017 is 7.6 miles per hour (mph).

Table 2-9 presents fugitive emission factors and Table 2-10 presents calculated fugitive emissions attributable to the Project. The impacts of fugitive sources of dust on air quality are discussed qualitatively in Section 5.

Table 2-9. Proposed Fugitive Emission Factors

Process	Emission Factor (lb/ton)		
	$PM_{2.5}$	**PM_{10}**	**Reference**
Screener (controlled)	1.11E-04	7.40E-04	$PM_{2.5}$: AP-42 Appendix B-2[1] PM_{10}: AP-42, 11.19.2
Rotary Dryer Feeder	1.92E-05	1.27E-04	AP-42 13.2.4[2]
Conveyor Belt	1.92E-05	1.27E-04	AP-42 13.2.4[2]

[1]Controlled screener emission factor used because contaminated soil likely has moisture content greater than 2.88%. Based on AP-42, Appendix B-1, $PM_{2.5}$ is 15% of Category 3 PM emissions.

[2]Continous drop emission factor calculated using Equation 1 in AP-42 13.2.4 (units: lb/ton), mean 2013-2017 KPAE wind speed of 7.6 mph, clay/dirt moisture content of 14%, and aerodynamic particle size multipliers (k) of 0.35 for PM_{10} and 0.053 for $PM_{2.5}$.

[7] https://www3.epa.gov/ttn/chief/ap42/appendix/appb-2.pdf

Table 2-10. Proposed Fugitive Emission Rates

Process	Emission Rates					
	(lb/hr)		(lb/day)		(tpy)	
	$PM_{2.5}$	PM_{10}	$PM_{2.5}$	PM_{10}	$PM_{2.5}$	PM_{10}
Screener (controlled)	6.66E-03	4.44E-02	1.60E-01	1.07E+00	2.50E-02	1.67E-01
Rotary Dryer Feeder	1.15E-03	7.60E-03	2.76E-02	1.82E-01	4.32E-03	2.85E-02
Conveyor Belt	1.15E-03	7.60E-03	2.76E-02	1.82E-01	4.32E-03	2.85E-02
Fugitive Sum	**8.96E-03**	**5.96E-02**	**2.15E-01**	**1.43E+00**	**3.36E-02**	**2.24E-01**

3. REGULATORY SETTING

The proposed TDU is subject to Federal, State and local regulations. The following section discusses the applicable regulations and why certain regulatory programs are not applicable. It should be noted that the project will be situated in an area that is in attainment of all ambient air quality standards.

3.1 Federal Regulations

3.1.1 Prevention of Significant Deterioration

A Prevention of Significant Deterioration (PSD) permit is required if potential facility-wide emissions of any one criteria pollutant exceeds 250 tons per year (tpy). As discussed in Section 1, the Project will not emit any pollutants equal to or greater than this threshold. Consequently, the Project does not require a PSD permit.

3.1.2 Air Operating Permit Program

Facilities that emit one or more criteria pollutants at a rate greater than or equal to 100 tpy, emit any single hazardous air pollutant (HAP) at a rate that exceeds 10 tpy, or emit all HAPs combined at a rate that exceeds 25 tpy are considered a major stationary source of emissions with respect to Title V of the Clean Air Act, and are required to apply for an Air Operating Permit (AOP). Because the Project will not emit pollutants at or greater than any of those thresholds, it is not required to submit an AOP application to PSCAA.

3.1.3 New Source Performance Standards

EPA has established performance standards that apply nationally to specific categories of stationary sources that are constructed, modified, or reconstructed after the standard was proposed. NSPS are found in 40 CFR Part 60. These NSPS usually represent a minimum level of control that is required of a new source.

Subpart A (General Provisions) applies to each facility that is considered an "affected facility" under any Part 60 NSPS rule. Subpart A contains general requirements for notifications, monitoring, performance testing, reporting, recordkeeping, and operation and maintenance. Because the Project is not considered an affected facility under any NSPS Subpart, Subpart A does not apply to the proposed TDU or associated equipment.

Subpart OOO (Standards of Performance for Nonmetallic Mineral Processing Plants) does not apply to the Project because contaminated soil will not pass through a grinding mill or a crusher. A portable crusher (PSCAA NOC No. 9259, issued August 5, 2005) may be periodically used to crush recycled asphalt product that will be stored at the Project site. The crushed asphalt may be used at other Cadman facilities or sold to other manufacturers. Additionally, the TDU is not considered a solid waste incinerator because soil is heated to drive off volatiles and not burned to reduce volume.

3.1.4 National Emission Standards for Hazardous Air Pollutants

The National Emission Standards for Hazardous Air Pollutants (NESHAPs) establish technology-based standards to control HAPs. For NESHAP purposes, a major source is defined as one with a potential to emit (PTE) greater than 10 tpy of a single HAP or more than 25 tpy of all HAPs combined. The HAP expected to be emitted by the Project in the greatest quantity is HCl at a rate of 3.5 tpy. The maximum potential facility-wide emissions of all HAPs combined would be 4.3 tpy. Table 3-1 presents HAP emissions associated with the proposed TDU.

Table 3-1. Project Potential Hazardous Air Pollutant Emissions

Pollutant[1]	CAS #	Emission Rate (TPY)
1,1,1-Trichloroethane	71-55-6	3.06E-04
Arsenic	7440-38-2	1.54E-03
Benzene[2]	71-43-2	9.50E-04
Beryllium	7440-41-7	3.50E-05
Cadmium	7440-43-9	8.16E-04
Chromium, hexavalent	18540-29-9	2.95E-04
Cobalt	7440-48-4	7.85E-03
Formaldehyde[2]	50-00-0	6.21E-02
Hexane	110-54-3	7.12E-01
Hydrogen chloride	7647-01-0	3.47E+00
Lead	7439-92-1	1.85E-03
Manganese	7439-96-5	4.04E-03
Mercury	7439-97-6	2.49E-04
Naphthalene	91-20-3	1.46E-03
Phosphorus	7223-14-0	1.23E-02
Selenium	7782-49-2	8.96E-04
Toluene	108-88-3	9.39E-03
o-Xylene	1330-20-7	1.41E-04
Sum of HAPs	--	4.29E+00

[1] List of HAPs found here: https://www3.epa.gov/airtoxics/orig189.html

[2] As a conservative appraoch, uncontrolled VOC HAP emission rates from TDU used.

Because the Project will not emit HAPs at a level that exceeds the PTE thresholds for either a single or combined HAP source, the Project does not qualify as a major source for NESHAP. Detailed HAP emission rate calculations are provided in Appendix B.

3.2 State and Local Emission Regulations

3.2.1 General Air Pollution Control Regulations

Regulations addressing general air pollution sources in Washington are contained in WAC 173-400. PSCAA has also established regulations that apply locally. Note that all of these general conditions will apply to the Project, which is not exempt from any general requirements.

General standards for maximum emissions from air pollution sources in Washington are outlined in WAC 173-400-040 and in PSCAA regulations. These regulations include:

- Limit visible emissions to 20 percent opacity except for 3 minutes per hour;
- Limit PM emissions to 0.02 gr/dscf;
- Require control of nuisance particulate fallout, fugitive dust, and odors; and
- Require that all equipment be operated and maintained properly.

Cadman expects that the project will operate in compliance with these regulations.

3.2.2 Notice of Construction Permits

Washington requires new or modified industrial sources to obtain an NOC air quality permit. The NOC permit application must provide a description of the facility, an inventory of pollutant emissions, and proposed control systems for the applicable pollutants. The reviewing agency considers whether BACT has been employed and evaluates ambient concentrations resulting from these emissions to ensure compliance with ambient air quality standards. As stated in WAC 173-400-113, an NOC permit cannot be granted unless the agency determines the project (1) will meet applicable state and federal emission limits; (2) will employ BACT; and (3) will not cause or contribute to violations of ambient air quality standards or TAP increments. This application provides the information to enable PSCAA to make those determinations.

Washington regulations require that a new source or modification employ BACT for all air pollutants not previously emitted, or whose emissions would increase as a result of the new source or modification. The BACT analysis evaluates the energy, environmental, economic, and other costs associated with each technology, and weighs those costs against the reduced emissions the technology would provide. BACT analyses for the TDU are presented in Section 4. Regulations also require a demonstration of compliance with the applicable air quality standards, which is typically accomplished through an air dispersion modeling analysis. The modeling analysis methodology and results are provided in Section 5.

3.2.3 Toxic Air Pollutants

PSCAA regulations require a demonstration that TAP emission increases attributable to the Project are sufficiently low to protect human health and safety from potential carcinogenic and other toxic effects. TAP emission increases that do not exceed the Small Quantity Emission Rates (SQERs) prescribed by WAC 173-460 are assumed to be sufficiently low that no additional analyses are warranted. If TAP emission increases exceed the SQERs, the applicant must demonstrate either that the ambient impact is less than the acceptable source impact levels ASIL or must conduct a second tier analysis as described in WAC 173-460.

As discussed in Section 2, Project TAP emission rates were used for comparison to the SQERs. Table 2-2 indicates that the calculated facility-wide emission rates of 12 TAPs exceed the applicable SQERs, and the air quality dispersion analysis conducted for those compounds to determine compliance with the ASILs is presented in Section 5. As described in Section 5, no species concentrations predicted by the model attributable to the Project are greater than the applicable ASILs, and, therefore, a second tier review is not required.

3.2.4 State Environmental Policy Ac

Because relocation of the proposed TDU requires Cadman to obtain an Order of Approval from PSCAA, the requirements of Washington's State Environmental Policy Act (SEPA) must be satisfied. A SEPA checklist will be submitted to the City of Everett, the SEPA lead agency.

4. BEST AVAILABLE CONTROL TECHNOLOGY ANALYSIS

As discussed in Section 3, among the requirements that must be met for PSCAA to issue an OAC is the requirement that proposed new or modified emission units will employ BACT and tBACT for all pollutants not previously emitted, or whose emissions would increase as a result of the project. The relocated TDU is considered a new emission unit at the Project site.

4.1 BACT Review Process

BACT, as it applies to regulated pollutants not subject to major new source review, is defined in WAC 173-400-030 as:

> "...an emission limitation based on the maximum degree of reduction for each air pollutant subject to regulation under chapter 70.94 RCW emitted from or which results from any new or modified stationary source, which the permitting authority, on a case-by-case basis, taking into account energy, environmental, and economic impacts and other costs, determines is achievable for such source or modification through application of production processes and available methods, systems, and techniques, including fuel cleaning, clean fuels, or treatment or innovative fuel combustion techniques for control of each such pollutant. "

In a December 1, 1987 memorandum from the U.S. EPA Assistant Administrator for Air and Radiation, the agency provided guidance on the "top-down" methodology for determining BACT. The "top-down" process involves the identification of all applicable control technologies according to control effectiveness. Evaluation begins with the "top," or most stringent, control alternative. If the most stringent option is shown to be technically or economically infeasible, or if environmental impacts are severe enough to preclude its use, then it is eliminated from consideration and then the next most stringent control technology is similarly evaluated. This process continues until the BACT level under consideration cannot be eliminated by technical or economic considerations, energy impacts, or environmental impacts. The top control alternative that is not eliminated in this process becomes the proposed BACT basis.

This top-down BACT analysis process can be considered to contain five basic steps:

- Step 1: Identify all available emission reduction alternatives with practical potential for application to the specific emission unit for the regulated pollutant under evaluation;
- Step 2: Eliminate all technically infeasible alternatives;
- Step 3: Rank remaining alternatives by effectiveness;
- Step 4: Evaluate the economic, energy, and environmental impacts starting with the most effective alternative; and
- Step 5: Select BACT, which will be the most effective practical alternative not rejected in the previous steps.

Formal use of these steps is not always necessary. However, EPA, Ecology, and PSCAA have consistently interpreted the statutory and regulatory BACT definitions as containing two core requirements, which EPA believes must be met by any BACT determination, regardless of whether it is conducted in a "top-down" manner. First, the BACT analysis must include consideration of the most stringent available technologies: i.e., those that provide the "maximum degree of emissions reduction." Second, any decision to require a lesser degree of emissions reduction must be justified by an objective analysis of "energy, environmental, and economic impacts" contained in the record of the permit decisions.

Additionally, the minimum control efficiency to be considered in a BACT analysis must result in an emission rate no less stringent than the applicable NSPS emission rate, if any NSPS is applicable to the source for that pollutant.

This BACT analysis was conducted in a manner consistent with this stepwise approach. Control options for potential reductions in criteria pollution emissions were identified for each emission unit. These options were identified by researching the EPA database known as the RACT/BACT/LAER Clearinghouse (RBLC), drawing upon previous environmental permitting experience for similar units and surveying available literature. Available controls that are judged to be technically feasible are further evaluated based on an analysis of economic, environmental, and energy impacts.

Assessing the technical feasibility of emission control alternatives is discussed in EPA's draft "New Source Review Workshop Manual." Using terminology from this manual, if a control technology has been "demonstrated" successfully for the type of emission unit under review, then it would normally be considered technically feasible. For an undemonstrated technology, "availability" and "applicability"

determine technical feasibility. An available technology is one that is commercially available; meaning that it has advanced through the following steps:

- Concept stage;
- Research and patenting;
- Bench scale or laboratory testing;
- Pilot scale testing;
- Licensing and commercial demonstration; and
- Commercial sales.

Suitability for consideration as a BACT measure involves not only commercial availability (as evidenced by past or expected near-term deployment on the same or similar type of emission unit), but also involves consideration of the physical and chemical characteristics of the gas stream to be controlled. A control method applicable to one emission unit may not be applicable to a similar unit, depending on differences in the gas streams' physical and chemical characteristics, or the design of the emission unit.

4.2 Soil Thermal Desorption Unit

A review of EPA's RBLC database was conducted for thermal desorption units used to treat contaminated soil. The most recent Order of Approval (OAC) for a soil treatment thermal desorption unit within PSCAA's jurisdiction was in 2014 for Iron Mountain Quarry in Granite Falls, Washington. The second most recent PSCAA OAC for a TDU (Number 8408, issued in 2001) is the TDU that Cadman is currently proposing to relocate from the Glenwood site to the Cadman Delta project site. Between 1989 and 2001, PSCAA issued 48 OACs for TDUs used to remediate contaminated soil. The only TDUs currently in operation within PSCAA's jurisdiction are those at the Cadman-Glenwood and Iron Mountain Quarry facilities.

For the vast majority of TDUs that have received permits through PSCAA, an afterburner (i.e., thermal oxidizer) or catalytic oxidizer has been used to reduce VOC and TAP emissions. Two facilities used wet scrubbers to control pollutants and the remaining facilities used (or use) baghouses to control PM emissions. Additionally, most OACs for TDUs issued by PSCAA impose limits on visibility, afterburner temperature, and hydrocarbon concentrations in the soil to be treated. Typical limits include 0.02 gr/dscf for total particulate (filterable and condensable combined), 10 percent opacity for visible emissions, and 1 lb/hr for non-methane

hydrocarbons (NMHCs), which includes VOCs in addition to hydrocarbons that do not participate significantly in ozone formation. A recent search of the RBLC revealed no additional information.

4.3 VOC BACT Analysis

VOC emissions are generally the result of incomplete fuel combustion. However, in the case of treating contaminated soil in the TDU, the greatest potential source of VOC emissions is the volatilization of contaminates in soil during treatment. As the contaminants are released from the soil as it is heated in the rotary drum dryer, a small portion of the volatiles escapes combustion by improper mixing with oxygen or zones of relatively low temperature, which is the same mechanism for VOC emissions that result from fuel combustion.

4.3.1 Identification of Possible Emission Reduction Alternatives

Combustion controls, or good combustion practices (GCPs), provide a wide range of control effectiveness depending on the configuration of the system. Generally, emissions resulting from incomplete combustion (CO and VOC) are balanced with emissions related to high furnace temperatures (NO_x) to achieve optimally low emissions of all pollutants.

In the case of a TDU, proper equipment design and operation are used to ensure that the maximum quantity of contaminants are removed from the soil and destroyed.

It is relatively common for other sources of VOCs, such as coating operations, to use Regenerative Thermal Oxidizers (RTOs) and Regenerative Catalytic Oxidizers (RCOs) to reduce VOC emissions. It is theoretically possible that a TDU could use such as system to reduce VOC emissions, though no instances of such an application have been identified.

4.3.1.1 Emission Reduction Alternative Review

A review of previous PSCAA BACT determinations for similar projects, along with a review of external sources, suggest that the use of an afterburner is sufficient to reduce VOC emissions when TDUs are used to remediate contaminated soil. GCPs are used to limit VOC emissions from the rotary drum dryer burner and the afterburner.

4.3.1.2 Summary of Possible Emission Reduction Alternatives

Based on literature and database searches the following control alternatives are possible for the TDU:

- None
- GCPs
- Direct-fired thermal oxidizers (i.e., afterburners)
- RTOs
- RCOs

The majority of TDUs in the database and literature searches use afterburners to reduce VOC emissions.

4.3.2 Technical Feasibility of Emission Reduction Alternatives

Afterburners are widely used to reduce VOC emissions from TDU exhaust streams, and are considered technically feasible. While there are no identified instances where TDUs have used an RTO or RCO to reduce VOC emissions, it is technically feasible to replace the existing afterburner with an RTO or RCO.

The use of GCPs to reduce emissions from combustion sources, including rotary drum dryer burners and afterburners, is a widely used VOC emission reduction technique, and is considered technically feasible.

4.3.3 Ranking of Technically Feasible Alternatives by Effectiveness

The VOC control efficiency for thermal and catalytic oxidizers is dependent on the make and model of the thermal and catalytic oxidizer.

Although the exact make and model of the afterburner currently used in the TDU at the Cadman Glenwood Facility is unknown, the VOC control efficiency for the afterburner used at the Iron Mountain Quarry facility in Granite Falls, WA is 99.8 percent. An afterburner is considered an effective method for controlling VOC emissions from a TDU.

4.3.4 Consideration of Economic, Energy, and Environmental Factors

The TDU proposed for installation at the Project Site already includes an afterburner. Considering the expense associated with installing and operating an RTO or RCO, with no increase in VOC destruction efficiency, it is clearly more cost effective to retain the existing afterburner. The lack of examples of RTOs or RCOs

used to reduce VOC emissions from TDUs, despite the assumed technical feasibility, speaks to the cost-ineffectiveness of those emission reduction alternatives.

4.3.5 Selection of BACT for VOCs

Based on the above analysis, BACT for VOC is proposed to be 0.02 pounds of VOC per ton of contaminated soil, which is equivalent to 1.2 pounds of VOC per hour with a throughput of 60 tons of soil per hour. These emission limits would be achieved using the existing afterburner installed on the proposed TDU.

4.4 PM_{10} and $PM_{2.5}$ BACT Analysis

PM_{10} and $PM_{2.5}$ are produced by combustion processes as unburned solid carbon (soot), unburned vapors or gases that subsequently condense, and the unburnable portion of the fuel (ash).

4.4.1 Identification of Possible Emission Reduction Alternatives

The concept of applying combustion controls or "proper combustion" to minimize PM emissions is similar to the strategy used to control VOC and includes adequate fuel residence time, proper fuel-air mixing, and temperature control to ensure the maximum amount of fuel is combusted. As discussed in the analysis of BACT for VOC emissions, optimization of these factors for PM control can result in an increase in the NO_x emissions. Thus, TDU operators strive to balance the factors under their control to achieve the lowest possible emissions of all pollutants.

Baghouses are the most popular add-on control technology for control of PM emissions from a TDU. Baghouses, or fabric filters, use various types of materials (generally fabrics) to trap particles while the gas passes through the voids in the material. The dust that becomes caked on the fabric bags is removed periodically by shaking, by blowing jets of air, or by using sonic horns.

Mechanical collectors, such as cyclones, or, more commonly, multi-cyclones ("multiclones"), use centrifugal force to separate PM from the exhaust flow. Exhaust enters at high velocity, and, as the shape of the cyclone turns the flow, the greater inertia of the PM makes it unable to make the same turn, and deposits on the sidewall of the cyclone. Multiclones are typically used to remove larger PM upstream of a primary control device (e.g., an ESP or baghouse) to prevent overloading.

Wet scrubbers, such as venturi scrubbers are less common because they typically have lower control efficiencies than either ESPs or baghouses, and complicate waste disposal by introducing liquids that create sludge when combined with the removed PM. A venturi is a narrowed section of duct followed by an expanded section of duct, with scrubbing liquid injected at the constricted section. The liquid is atomized by the increased velocity exhaust flow, and the particles impact the droplets and are collected. Because the liquid must be atomized to ensure high collection efficiency, a high-energy exhaust flow is required.

4.4.1.1 Emission Reduction Alternative Review

A review of the RBLC indicates that the most stringent control technology for PM_{10} and $PM_{2.5}$ from TDUs is use of a baghouse. The majority of TDU permits in the RBLC have a permit limit of 0.02 gr/dscf (total particulate, including both filterable and condensable fractions).

4.4.1.2 Summary of Possible Emission Reduction Alternatives

Based on literature and database searches, the following control alternatives are possible for the proposed TDU:

- Mechanical collector, such as a multiclone
- Baghouse
- Venturi scrubber

4.4.2 Technical Feasibility of Emission Reduction Alternatives

The most common technology for controlling PM_{10} and $PM_{2.5}$ emissions from a TDU is a baghouse (fabric filter). Venturi scrubbers, when used, are generally employed to control PM_{10} and $PM_{2.5}$ from operations with relatively small exhaust flows, and typically have lower control efficiencies than baghouses.

4.4.3 Ranking of Technically Feasible Alternatives by Effectiveness

This section briefly describes the effectiveness of the remaining technologies.

Mechanical Collectors

Single cyclones or multiclones are capable of reducing PM emissions by between 5 and 75 percent, depending upon the size distribution. It is unusual for a mechanical collector to be the sole emission reduction system employed to control PM from a TDU, such devices are almost always used in conjunction with another technology. There are no examples of mechanical collectors being used to reduce PM emissions

from a TDU; as a result, this emission reduction alternative is eliminated from consideration as BACT for reducing PM emissions from a TDU.

Venturi Scrubbers

Venturi scrubbers with pressure drops of between 5 and 10 inches of water typically remove less than 99 percent of PM_{10} and $PM_{2.5}$ from exhaust flows. Units with pressure drops of 20 inches of water or greater can remove greater than 99 percent of PM_{10} and $PM_{2.5}$. There are no examples of Venturi scrubbers being used to reduce PM emissions from a TDU; as a result, this emission reduction alternative is eliminated from consideration as BACT for reducing PM emissions from a TDU.

Baghouses

Baghouses typically operate with pressure drops between 2 and 12 inches of water. PM_{10} and $PM_{2.5}$ control efficiencies are capable of removing more than 99 percent of PM_{10} and $PM_{2.5}$ from gas streams. Baghouses are commonly applied to reduce PM emissions from TDUs.

A baghouse is the only remaining technologically feasible emission reduction alternative for PM emissions from a TDU.

4.4.4 Consideration of Economic, Energy, and Environmental Factors

The proposed TDU is already equipped with a baghouse. Because a baghouse is considered the most effective emission reduction alternative under consideration as BACT, no consideration of economic, energy, and environmental factors is necessary.

4.4.5 Selection of BACT for PM_{10} and $PM_{2.5}$

Cadman proposes that BACT for PM_{10} and $PM_{2.5}$ emissions from a TDU is 0.02 gr/dscf, achieved using a baghouse.

4.5 NO_x BACT Analysis

NO_x is generated when combustion temperatures are high enough for the nitrogen in the combustion air or bound in the fuel to combine with oxygen to form NO. Depending upon conditions, some portion of the NO will react to form NO_2.

4.5.1 Identification of Possible Emission Reduction Alternatives

There are a variety of options available for controlling NO_x emissions from combustion sources. Some options involve combustion controls that reduce NO_x formation, while others utilize add-on control devices to remove NO_x after it is formed.

Combustion controls reduce NO_x emissions by controlling the combustion temperature and the availability of oxygen. Combustion air containing both nitrogen and oxygen can combine in a high temperature environment to form thermal NO_x. The oxidation of nitrogen that is chemically bound in fuel sources can also form what is called fuel-bound, or "prompt," NO_x. For natural gas combustion, prompt NO_X is typically negligible compared to thermal NO_X.

GCPs include combustor design elements and operational strategies intended to control the amount and distribution of excess air in the combustion zone to ensure that enough oxygen is present for complete combustion, while not creating high temperatures that promote the creation of NO_X.

Techniques intended to reduce NO_X emissions by reducing oxidation temperatures in the combustion zone include flue gas recirculation (FGR), staged combustion, overfire air injection (OFA), and water/steam injection. All of these practices seek to limit the creation of NO_X by limiting peak combustion temperatures and/or controlling the mixture of oxygen and fuel.

FGR employs both mechanisms, because introducing cooled flue gas into the combustion zone reduces the temperature of the combustion zone by absorbing heat, and the relatively oxygen-poor flue gas also reduces the oxygen content in the combustion zone. Staged combustion and OFA injection are similar techniques that both restrict the amount of oxygen available at the start of the combustion process by providing too little combustion air, and then introducing additional air later. By limiting the availability of oxygen to the fuel, combustion temperatures and NO_X creation are both reduced. Water or steam injected into the combustion zone absorbs heat, which reduces the flame temperature, and, therefore, NO_X creation. Because CO and VOC emissions are minimized by high temperatures and oxygen/fuel interaction, these techniques tend to increase CO and VOC emissions.

Low-NO_X Burners (LNBs) are similar to the oxidation temperature minimization techniques described above, but the staged combustion of fuel that controls NO_X

formation is accomplished through burner design rather than manipulating combustion in the furnace. The design controls both the stoichiometry and temperature of combustion by tuning the fuel and air locally within each individual burner's flame envelope. Burner design includes features that regulate the aerodynamic distribution and mixing of the fuel and air. A lean, pre-mixed burner design mixes the fuel and air prior to combustion. This results in a homogeneous air/fuel mixture, which minimizes localized fuel-rich pockets that produce elevated combustion temperatures and higher NO_X emissions. A lean fuel-to-air ratio approaching the lean flammability limit is maintained, and the excess air serves as a heat sink to lower the combustion temperature, which in turn reduces NO_X formation. A pilot flame is used to maintain combustion stability in this fuel-lean environment. LNBs that feature an FGR system integrated into the burner design, which further minimizes flame temperatures and oxygen availability, are often referred to as ultra-low NO_X burners (ULNBs).

Add-on controls such as selective catalytic reduction (SCR) and selective non-catalytic reduction (SNCR) systems are widely used technologies for controlling NO_x emissions from combustion sources. In the SCR process, ammonia in some form (anhydrous, aqueous, or in urea) is mixed with the exhaust from the combustion device and the mixture is passed through a catalyst bed. The NO_x reacts with the ammonia aided by the catalyst to form nitrogen and water.

The SNCR process is similar to SCR in that a reagent reacts with NO_x to form nitrogen and water, although no catalyst is used to aid the reaction. The catalyst used in SCR systems allows the reactions to occur at lower temperatures than is possible in SNCR systems (450 ºF for SCR as opposed to 1,550 ºF for SNCR). The reagent, which, as for SCR, can be urea, aqueous ammonia, or anhydrous ammonia, is typically vaporized and mixed with hot flue gas from the combustion device. Hybrid SNCR/RSCR systems, in which a catalyst bed is located downstream of the SNCR system, have been developed where the unreacted ammonia injected by the SNCR system is used by the catalyst to further reduce NO_x emissions.

EMx (formerly known as $SCONO_x$) is similar to SCR, except that NO_x in the exhaust stream reacts with potassium carbonate (K_2CO_3) to form potassium nitrate (KNO_3). This compound is reacted with hydrogen to form gaseous nitrogen (N_2) and regenerate the K_2CO_3. The lower exhaust temperature limit required for the

reactions in the EMx to take place is less than that of SCR (300 ºF as opposed to 450 ºF). The EMx system is also said to control CO and VOCs by oxidation.

4.5.1.1 Emission Reduction Alternative Review

Based on the information gathered and outlined above, the following alternatives were identified for reducing NO_x emissions from a TDU:

- GCPs
- Low-NOx burners (LNBs)

The database queries did not produce any instances of NO_x emissions from TDU controlled by FGR, staged combustion, OFA, water/steam injection, SCR, RSCR, SNCR/RSCR hybrid systems, or EMx, so those alternatives have been removed from consideration.

For the most recent TDU permitted for contaminated soil treatment, BACT was determined to be good combustion practices and use of AP-42 fuel oil combustion emission factors.

4.5.1.2 Summary of Possible Emission Reduction Alternatives

Based on literature and database searches, the following alternatives are possible for reducing NO_x emissions from a TDU:

- GCPs
- LNBs

4.5.2 Technical Feasibility of Emission Reduction Alternatives

In this section, the technical feasibility of each of the emission reduction alternative identified in the previous section is considered.

4.5.2.1 GCPs

Proper combustion refers to the application of state-of-the-art design and appropriate operation of a combustion unit. Proper combustion is a ubiquitous and technically feasible technology for controlling NO_x emissions from TDUs.

4.5.2.2 LNBs

While it is theoretically possible to use LNBs for both the rotary drum dryer burner and the afterburner, the temperature produced by those burners must be sufficient to volatilize and destroy VOCs and HAPs. Because the use of LNBs would likely

reduce the effectiveness of the TDU, and no instance of LNB use in a TDU could be identified, LNBs are removed from consideration as BACT.

4.5.2.3 Summary of Technically Feasible Alternatives

Employing GCPs is the most technically feasible option for controlling NO_X emissions from TDUs.

4.5.3 Ranking of Technically Feasible Alternatives by Effectiveness

Using GCPs is the only technically feasible option remaining for controlling NO_X emissions from TDUs.

4.5.4 Consideration of Economic, Energy, and Environmental Factors

Because the sole remaining NO_X emission reduction alternative, the use of GCPs, will be employed by the proposed TDU, no consideration of economic, energy, and environmental factors is required.

4.5.5 Selection of BACT for NO_x

Based on the analysis presented in this section, Cadman proposes that BACT for NO_X emissions from the proposed TDU is achieved through the use of GCPs.

4.6 CO BACT Analysis

CO is a product of the chemical reaction between carbonaceous fuels and oxygen. In fuel-rich mixtures, CO occurs as the product of combustion. In fuel-lean mixtures CO can result due to poor mixing of fuel and air in the combustion zone (so the sub-region is fuel-rich) or because of very high temperatures in the combustion zone (greater than 1,727 °C), which causes dissociation of CO_2 into CO.[8]

4.6.1 Identification of Possible Emission Reduction Alternatives

The technology options available for controlling CO emissions from combustion sources include combustion controls and add-on control devices. CO combustion controls promote more complete oxidation to limit CO emissions and seek to oxidize CO to CO_2 after it has left the combustion area.

Combustion controls for CO include adequate fuel residence times to ensure CO_2 formation, proper fuel-air mixing, and maintaining temperatures that ensure complete oxidation. These measures, however, can result in an increase in the NO_X

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[8] Wark, K; Warner, C. *Air Pollution: Its Origin and Control.* Harper and Row Publishers; NY, NY: 1981

emissions from a combustion unit. Thermal desorption units strive to balance these competing factors, and when combined with appropriate operation of the TDU are considered GCPs.

Good combustion practices are an effective CO control technology and the most popular add-on technologies used to control CO emissions are thermal and catalytic oxidizers.

Thermal oxidizers use heat to break down CO. In addition to direct-fired thermal oxidizers (afterburners), other types of thermal oxidizers, such as RTOs, can be employed as control technology. Regenerative thermal oxidizers use a heated ceramic bed to partially oxidize gases. Gases are then fully oxidized in a downwind chamber heated to temperatures up to 2,000°F. Additionally, RCOs can be used to control CO emissions. RCOs use a matrix or "bed" coated with noble metals (e.g., platinum) to facilitate the conversion of a criteria pollutant to a non-pollutant (in this case CO to CO_2). Catalytic oxidizers used for CO control typically operate in a temperature range of approximately 500 °F to 1,000 °F, and thermal oxidizers operate at higher temperatures, ranging from 1,500°F to 2,000°F. In some cases, fuel use must be increased to maintain the CO-to-CO_2 conversion efficiency, which falls off rapidly at lower temperatures.

EMx (described in the NO_X BACT analysis) also utilizes a catalytic technique that oxidizes CO to CO_2 in addition to reducing NO_X emissions.

4.6.1.1 Emission Reduction Alternative Review

The following technologies were found in the databases searched for controlling CO from TDUs:

- GCPs
- Direct-fired thermal oxidizers (afterburners)
- Regenerative thermal oxidizers (RTO)
- Regenerative catalytic oxidizers (RCO)
- EM_x

The majority of TDUs in the database use afterburners to control CO emissions.

4.6.1.2 Summary of Possible Emission Reduction Alternatives

Based on literature and database searches the following control alternatives are possible for the TDU:

- GCPs
- Direct-fired thermal oxidizers (afterburners)

There are no examples of TDUs using EMx, RTOs, or RCOs to control CO emissions, therefore those emission reduction alternatives are removed from consideration as BACT for reducing CO emissions from TDUs.

4.6.2 Technical Feasibility of Emission Reduction Alternatives

Use of an afterburner is the most common CO emission control technology for TDUs. It is technically feasible to install a different thermal oxidizer or catalytic oxidizer, although the afterburner currently installed is effective at reducing CO emissions.

The use of GCPs to reduce emissions from combustion sources, including rotary drum dryer burners and afterburners, is a common CO emission reduction technique that is technically feasible.

4.6.3 Ranking of Technically Feasible Alternatives by Effectiveness

Similar to VOC control efficiency, CO control efficiency for thermal oxidizers is dependent on the make and model of the oxidizer. Thermal oxidation is generally capable of providing between 40 and 99 percent reduction in CO emissions. The use of an afterburner and employing GCPs are both effective ways to reduce CO emissions.

4.6.4 Consideration of Economic, Energy, and Environmental Factors

Because the two most effective emission reduction alternatives (i.e., a thermal oxidizer and GCPs) will be employed to reduce CO emissions from the proposed TDU, no consideration of economic, energy, and environmental factors is necessary.

4.6.5 Selection of BACT for CO

Based on the analysis presented in this section, Cadman proposes that BACT for CO emissions from a TDU is the use of GCPs and an afterburner.

4.7 SO_2 BACT Analysis

Sulfur dioxide (SO_2) emissions are dependent upon the amount of sulfur present in the fuel used in the rotary dryer and the afterburner. Emissions are also dependent on the type of fuel present in the contaminated soil. Sulfur contained in fuel combines with oxygen at combustion temperatures to form SO_2.

4.7.1 Identification of Possible Emission Reduction Alternatives

There are two alternatives for reducing SO_2 emissions combustion sources: removal of sulfur from the fuel before it is combusted, and removal of SO_2 from the exhaust gas after combustion.

Removing sulfur from fuel before it is combusted has been employed to remove sulfur-containing nonorganically-bound minerals (e.g., pyrites) from coal.

Scrubbing, or flue gas desulfurization (FGD) systems remove SO_2 from the exhaust gases after they leave the burner using a slurry of lime or limestone (some systems use sodium or other sorbent materials) and water into a chamber which the gases pass through. The sorbent in the slurry comes in contact with the SO_2 in the exhaust gas and reacts with it. Depending upon the design of the system, the reacted sorbent slurry can remain wet or be dried by the hot exhaust such that only dry reacted sorbent remains. In dry FGD systems and spray driers, the particulate control system (usually a fabric filter) must be sized to handle the additional load created by the SO_2 control system. Both wet and dry FGD systems require waste handling operations to remove the reacted sorbent material.

4.7.1.1 Emission Reduction Alternative Review

The results of the database queries for SO_2 control technologies reveal that permit limits are often imposed on the amount of sulfur contained in diesel fuel.

4.7.1.2 Summary of Possible Emission Reduction Alternatives

Based on literature and database searches the following control alternatives are possible for the TDU:

- Limit amount of sulfur present in the fuel
- FGD

4.7.2 Technical Feasibility of Emission Reduction Alternatives

There are no instances of FGD technology being used to reduce SO_2 emissions from a thermal desorption unit used to remediate soil. FGD is removed from consideration as BACT for reducing SO_2 emissions from the proposed TGU.

Natural gas, a low-sulfur fuel, is commonly used by TDUs, and will be used exclusively in the burner used to heat the rotary dryer and the afterburner.

4.7.3 Ranking of Technically Feasible Alternatives by Effectiveness

Using a low-sulfur fuel such as natural gas is the only technically feasible alternative for reducing SO_2 emissions from a TDU.

4.7.4 Consideration of Economic, Energy, and Environmental Factors

Because the proposed TDU will employ the only technically feasible SO_2 emission reduction alternative, no consideration of economic, energy, and environmental factors is necessary.

4.7.5 Selection of BACT for SO_2

Cadman proposes that BACT for reducing SO_2 emissions from a TDU is the exclusive use of natural gas to fuel the rotary dryer burner and the afterburner.

4.8 Toxic Air Pollutant BACT Analysis

Toxic air pollutant (TAP) compounds emitted by the TDU during the soil remediation process are, in general, either volatiles (VOCs) or PM (PM_{10} and $PM_{2.5}$). The proposed BACT for VOC and PM are also proposed to be tBACT for VOC and PM TAPs, respectively. tBACT for TAPs that contain chlorine (e.g., HCl) is proposed to be the same as that proposed for SO_2. For nitrogen-containing compounds, tBACT for nitric oxide (NO) is proposed to be the same as that proposed for NO_x.

5. AIR QUALITY IMPACT ANALYSIS

An OAC cannot be issued by PSCAA to a proposed new or modified source without a demonstration that the emission increases attributable to the proposed project will not cause or contribute to a violation of any ambient air quality standard, and that increases in TAP emissions are sufficiently low to protect human health and safety. Dispersion modeling analyses are typically used to predict ambient air concentrations attributable to the proposed project for such demonstrations. This chapter documents the near-field air quality impact analysis developed for the proposed relocation of the TDU to the Project Site.

5.1 Model Selection

Ramboll reviewed regulatory modeling techniques to select an appropriate air quality model to simulate dispersion of air pollutants emitted by the proposed project for a near-field air quality impact analysis. The selection of regulatory modeling tools is influenced by situations where exhaust plumes have the potential to interact with onsite structures (i.e., "building downwash") or impact complex terrain. There are several onsite structures with the potential to interact with exhaust plumes, and there is complex terrain within the modeling domain. As a result, the dispersion model selected for the analysis will be required to consider both complex terrain and building downwash effects to allow for the possibility of emissions from stacks shorter than dictated by Good Engineering Practice (GEP).

EPA's "Guideline of Air Quality Models" in 40 CFR 51 Appendix W ("the Guideline") recommends the use of AERMOD in this situation. AERMOD was specifically designed to estimate impacts of air pollutants in areas containing both simple and complex terrain. AERMOD also includes the PRIME downwash algorithms to estimate effects of surrounding buildings on the dispersion of plumes. Ramboll used the latest version of AERMOD (Version 18081) for the dispersion modeling analysis.

5.2 Modeling Procedures

Ramboll applied AERMOD to model criteria pollutant and TAP emission rates using the regulatory defaults in addition to the options and data discussed below. The option to adjust the surface friction velocity (U*) for low wind or stable conditions is now considered a regulatory default setting and was used in this analysis. The option was applied without the Bulk Richardson Number option. An archive of modeling files will be provided for review.

5.3 Averaging Periods

Ambient pollutant concentrations were calculated using AERMOD for averaging periods as required for comparison to applicable regulatory thresholds. For comparison against the SILs, ASILs, and NAAQS, a variety of pollutant averaging periods were used to calculate ambient concentrations in AERMOD, as required by the applicable ambient criteria for each modeled pollutant. These averaging periods include 1-hour, 24-hour, and annual averaging periods.

5.4 Elevation Data and Receptor Network

Terrain elevations for receptors were prepared using 1/3th arc-second elevation data from the National Elevation Dataset (NED), which is a product of the United States Geological Survey (USGS). The NED is a seamless elevation dataset covering the continental United States, Alaska, and Hawaii. The elevation dataset for the modeling demonstration was downloaded from USGS (http://seamless.usgs.gov). These data have a horizontal spatial resolution of approximately 10 meters (m).

For the dispersion model analyses, receptors were spaced 500 meters apart covering the 10 kilometer (km) square simulation domain (shown in Figure 5-1), with a 5-km-by-5-km nested receptor grid with 200-m receptor spacing, a 3-km-by-3-km nested receptor grid with 50-m receptor spacing, and a 1.8-km-by-1.8 km nested receptor grid with 25-m receptor spacing. All receptor grids were centered on the location of the proposed project. Receptors were also located at 10-m intervals along ambient air boundary of the Project Site. The final receptor locations are shown in Figure 5-1. The base elevation and hill height scale for each receptor were determined using the EPA's terrain processor AERMAP (Version 18081), which generates the receptor output files that are read by AERMOD. All receptor locations are in Universal Transverse Mercator (UTM) coordinates using the spatial reference of NAD 83, Zone 10.

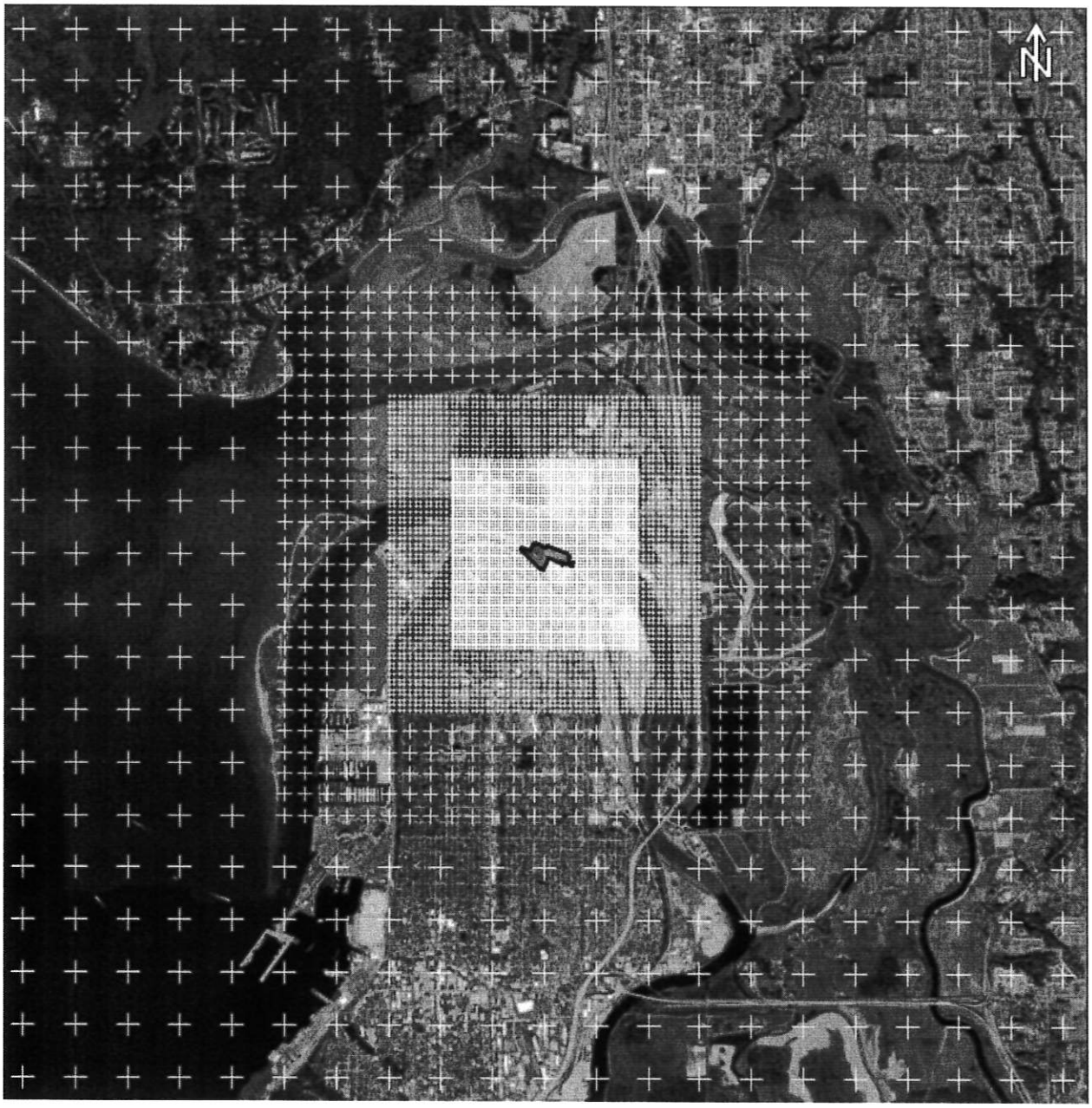

Figure 5-1. Receptor Locations

5.5 Meteorological Data

Ramboll conducted a survey of available meteorological data for use in the modeling simulations. A representative five-year data set was prepared using available surface and upper air data for the period 2013 through 2017. Surface meteorology data from the Snohomish County Airport (Paine Field) in Everett, WA and upper air data collected at the National Weather Service (NWS) station in

Quillayute, Washington were used. A windrose summarizing the Paine Field wind speed and wind direction data is provided in Figure 5-2. Statistics for other meteorological data at Paine Field, including stability, cloud cover, precipitation, and temperature are presented in Figure 5-2 as well.

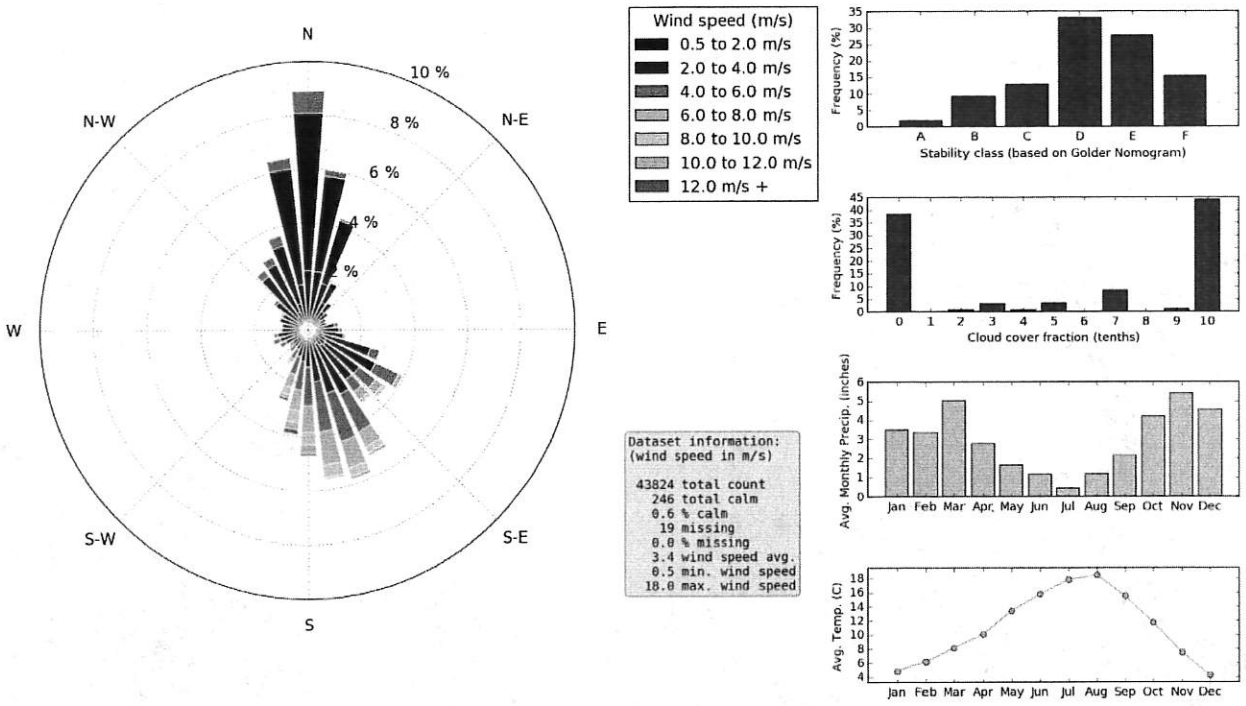

Figure 5-2. Paine Field Windrose with Additional Meteorological Statistics

Additional meteorological variables and geophysical parameters are required for use in the AERMOD dispersion modeling analysis to estimate the surface energy fluxes and construct boundary layer profiles. Surface characteristics including albedo, Bowen ratio, and surface roughness length were determined for the area surrounding the Paine Field meteorological station using the AERMET surface characteristic pre-processor, AERSURFACE (Version 13016), and USGS NLCD landuse data.

The EPA meteorological program AERMET (Version 18081) was used to combine the surface meteorological observations collected by the Paine Field meteorological station with the twice-daily upper air soundings from Quillayute, Washington and to

calculate the meteorological variables and profiles required by AERMOD. Additionally, 1-minute ASOS meteorological data from Paine Field was used in this analysis.

5.6 Modeled Criteria Pollutant Emissions

The proposed soil thermal desorption unit will result in potential emissions of all criteria pollutants. The "project-only" concentrations resulting from this analysis were compared to the Significant Impact Levels (SILs) provided in WAC 173-400-113(4)(a). Calculated ambient concentrations less than these screening thresholds indicate that the emission increases associated with the project do not have the potential to cause or contribute to a violation of any ambient air quality standard. If a predicted concentration exceeds the applicable SIL, the impact of all emission units at the facility, proposed and existing, may also need to be considered, as well as the contribution of other sources, which are typically represented by adding a background concentration.

The criteria pollutant emission increases associated with the proposed TDU at the Cadman Delta Site are summarized in Table 5-1. These emissions are incorporated into AERMOD and used to compare modeled concentrations to the SILs.

Table 5-1. Modeled Project-Only Criteria Pollutant Emissions for SIL Analysis

	Emission Rate			
	Thermal Desorption Unit[1,2]			
	Hourly		Annual	
Pollutant	(lb/hr)	(g/s)	(tpy)	(g/s)
NO_x	1.74E+01	2.20E+00	6.55E+01	1.88E+00
CO	1.06E+01	1.33E+00	3.97E+01	1.14E+00
SO_2	2.52E+00	3.17E-01	9.50E+00	2.72E-01
PM_{10}	8.70E+00	1.10E+00	3.26E+01	9.39E-01
$PM_{2.5}$	8.70E+00	1.10E+00	3.26E+01	9.39E-01
VOC	1.25E+00	1.58E-01	4.70E+00	1.35E-01

[1] Emissions from the contaminated soil, rotary burner, baghouse, an afterburner are combined and exit simutaneously through the afterburner stack.

[2] Emission rate based on 7,509 operational hours per year.

5.7 Modeled Toxic Air Pollutant Emissions

Washington regulations, adopted by PSCAA, require a demonstration that TAP emission increases attributable to new or modified emission units will not exceed

certain ambient concentration thresholds, called "acceptable source impact levels" (ASILs), which are designed to protect human health and safety. Regulations also provide emission levels, called "small quantity emission rates" (SQERs), below which a modeling demonstration is not required. This process is referred to as a "first tier review." The regulations that describe the first tier review process (WAC 173-460-080) permit the inclusion of reductions in actual TAP emissions from existing emission units at the source, for the purpose of offsetting emissions of the same TAP attributable to a new or modified emission unit.

As shown in Table 2-2, the increase in NO_x, SO_2, 7,12-dimethylbenz(a)anthracene, arsenic, beryllium, cadmium, hexavalent chromium, cobalt, formaldehyde, hydrogen chloride, manganese, and vanadium emissions attributable to the project are larger than the applicable SQER, and, therefore, a modeling demonstration to assess compliance with the ASIL is required for these TAPS.

TAPs emission increases associated with the TDU at the Project Site are summarized in Table 5-2.

Table 5-2. Modeled Toxic Air Pollutant Emissions

Pollutant	Averaging Period	Emission Rate[1,2]	
		Thermal Desorption Unit[2]	
		(lb/avg. period)[3]	(g/s)
NO_x	1-hr	1.74E+01	2.20E+00
SO_2	1-hr	2.52E+00	3.17E-01
7,12-Dimethylbenz(a)anthracene[3]	year	1.27E-02	1.82E-07
Arsenic	year	3.58E+00	5.15E-05
Beryllium	year	8.16E-02	1.17E-06
Cadmium	year	1.90E+00	2.74E-05
Chromium, hexavalent	year	6.88E-01	9.89E-06
Cobalt	24-hr	5.02E-02	2.63E-04
Formaldehyde[3]	year	1.45E+02	2.08E-03
Hydrogen chloride	24-hr	2.22E+01	1.16E-01
Manganese	24-hr	2.58E-02	1.36E-04
Vanadium	24-hr	2.70E-01	1.42E-03

[1] Emissions from the contaminated soil, rotary burner, baghouse, and afterburner are combined and exit simutaneously through the afterburner stack.

[2] Emission rate based on 7,509 operational hours per year.

[3]In conservative approach, uncontrolled VOC TAP emission rates from TDU are used in modeling.

5.8 Emission Unit Release Parameters

Figure 2-2 shows the layout of the facility as it will be following the proposed project, superimposed on a recent aerial photograph of the facility. Locations of proposed new emission units are indicated, as well as significant structures that could potentially influence emissions.

Table 5-3 provides a summary of the parameters used to represent exhaust from the TDU.

Table 5-3. Release Parameters for Proposed Equipment

Emission Unit	Height (ft / m)	Temperature (°F / K)	Exit Velocity (ft/s / m/s)	Inside Diameter (ft / m)
Proposed Thermal Desorption Unit Afterburner Stack	48.0 / 14.6	1500.0 / 1074.5	72.2 / 22.6	6.0 / 1.8

In addition to the release parameters discussed above, the building dimensions and facility configuration were provided to AERMOD to assess potential downwash

effects. Wind direction-specific building profiles were prepared for the modeling using EPA's Building Profile Input Program including the PRIME algorithm (BPIP PRIME). The facility layout and heights of proposed new and retained existing structures, as shown in Figure 2-2 and Table 5-4, were used to prepare data for BPIP PRIME, which calculates the necessary input data for AERMOD. Note that the two open-sided storage buildings are not included in BPIP because they do not contain any walls.

Table 5-4. Significant Onsite Structure Heights

Structure	Proposed or Existing	Height Above Grade	
		(ft)	(m)
Breakroom	Proposed	40.0	12.2
Scale House	Proposed	40.0	12.2
Container for Parts and Shop Space	Proposed	40.0	12.2
Container for Parts and Shop Space	Proposed	40.0	12.2

5.9 Results of the Project-Only Criteria Pollutant Analysis

Ambient criteria pollutants and TAP concentrations attributable to the project were evaluated using the inputs described in this section. Table 5-5 compares AERMOD-predicted maximum criteria pollutants concentrations to applicable SILs. The SILs represent incremental, project-specific impact levels that the State of Washington accepts as insignificant with respect to assessing compliance with the National Ambient Air Quality Standards (NAAQS) or the Washington Ambient Air Quality Standards (WAAQS, which, for most criteria pollutants, are currently identical to the NAAQS). As shown in Table 5-5, the design concentration predicted by AERMOD for 1-hour average NO_2 and 24-hour average $PM_{2.5}$ exceed the corresponding SILs. As a result, a cumulative analysis is required to determine compliance with the NAAQS, which is typically accomplished by adding a background value to facility-wide modeling results. The NAAQS compliance demonstration is described in the next section.

Table 5-5. Predicted Project-Only Maximum Model Concentrations				
Pollutant	**Averaging Period**	**Design Concentration (µg/m³)**	**SIL[1] (µg/m³)**	**Over SIL?**
PM_{10}	24-Hour	4.32E+00	5.00E+00	No
$PM_{2.5}$	24-Hour	2.50E+00	1.20E+00	Yes
	Annual	1.26E-01	3.00E-01	No
SO_2	1-Hour	1.99E+00	7.80E+00	No
	3-Hour	2.36E+00	2.50E+01	No
	24-Hour	1.25E+00	5.00E+00	No
	Annual	5.46E-02	1.00E+00	No
NO_2	1-Hour	1.38E+01	7.50E+00	Yes
	Annual	3.78E-01	1.00E+00	No
CO	1-Hour	1.26E+01	2.00E+03	No
	8-Hour	7.70E+00	5.00E+02	No
[1]SIL = Significant Impact Level, from WAC 173-400-113				

5.10 Results of the Toxic Air Pollutant Analysis

The results of the TAP dispersion modeling analysis are summarized in Table 5-6, where modeling results are compared with the applicable ASILs. As shown in the table, no species predicted by the model attributable to the proposed TDU are greater than the applicable ASILs and a second tier review is not necessary. Uncontrolled emissions of VOC TAPs are used in dispersion modeling, which is a conservative approach. As a result, VOC TAPs concentrations will be lower than those reported in Table 5-6.

Table 5-6. Maximum Predicted Project-Only Toxic Air Pollutant Concentrations					
Toxic Air Pollutant	**CAS #**	**Averaging Period**	**Maximum Concentration (µg/m³)**	**ASIL (µg/m³)**	**Over ASIL?**
NO_x	10102-44-0	1-hr	1.38E+01	4.70E+02	No
SO_2	630-08-0	1-hr	1.99E+00	6.60E+02	No
7,12-Dimethylbenz(a)anthracene	57-97-6	year	3.65E-08	1.41E-05	No
Arsenic	7440-38-2	Annual	1.04E-05	3.00E-04	No
Beryllium	7440-41-7	Annual	2.36E-07	4.00E-04	No
Cadmium	7440-43-9	Annual	5.50E-06	2.00E-04	No
Chromium, hexavalent	18540-29-9	Annual	1.99E-06	6.67E-06	No
Cobalt	7440-48-4	24-hr	1.04E-03	1.0E-01	No
Formaldehyde	107-06-2	Annual	4.19E-04	1.67E-01	No
Hydrogen Chloride	7647-01-0	24-hr	4.60E-01	9.0E+00	No
Manganese	100-41-4	24-Hour	5.36E-04	4.00E-02	No
Vanadium	7440-62-2	24-hr	5.59E-03	2.0E-01	No

5.11 Ambient Standard Compliance Demonstration

Because the predicted 1-hour average NO_2 and 24-hour average $PM_{2.5}$ project-only design concentrations exceed the SILs, a cumulative analysis is required to assess compliance with the ambient standards for those pollutants and averaging periods. A cumulative modeling analysis includes all existing emission units that will remain following the proposed project, as well as all proposed new emission units. There are currently no existing emission units at the Facility. Additionally, to account for other sources, a representative background concentration is added to the design concentration.

Results of the cumulative modeling analysis are summarized in Table 5-7. As shown in the table, the model-predicted design concentrations, with representative background concentrations added, are less than the applicable ambient standards in all cases.

Although fugitive PM emissions were not modeled in AERMOD, fugitive impacts on air quality can still be assessed. Baghouse $PM_{2.5}$ emissions are over 950 times larger than fugitive $PM_{2.5}$ emissions, and baghouse PM_{10} emissions are 145 times larger than fugitive PM_{10} emissions. If fugitive PM emissions (Table 2-9) are added to baghouse PM emissions (Table 2-7), $PM_{2.5}$ emissions and PM_{10} emissions from the Facility are increased by a minimal amount (factor of 1.0010 and 1.0069,

respectively) and estimated design concentrations (model + background) are still well below the NAAQS for both $PM_{2.5}$ and PM_{10}.

Table 5-7. Predicted Facility-Wide Design Concentrations

Pollutant	Averaging Period	Concentration (µg/m³)				Over NAAQS/ WAAQS?
		Design	Background[3]	Total[4]	NAAQS/ WAAQS[5] (µg/m³)	
PM_{10}[1]	24-Hour	2.06E+00	4.80E+01	5.01E+01	1.50E+02	No
$PM_{2.5}$[1]	24-Hour	8.84E-01	3.00E+01	3.09E+01	3.50E+01	No
	Annual	1.26E-01	7.90E+00	8.03E+00	1.20E+01	No
NO_2[2]	1-Hour	9.60E+00	8.65E+01	9.61E+01	1.88E+02	No
	Annual	3.78E-01	2.44E+01	2.48E+01	1.00E+02	No

[1] Design concentrations are the highest 6th-high 24-hour average PM_{10} concentration over five modeled years, the highest 5-year average of the 98th percentile 24-hour average $PM_{2.5}$ concentrations at each receptor, and the highest 5-year average of the annual average $PM_{2.5}$ concentrations at each receptor. (based on guidance in the "Modeling Procedures for Demonstrating Compliance with the $PM_{2.5}$ NAAQS" memorandum issued on March 23, 2010 by Stephen Page, Director of OAQPS).

[2] Design concentrations are the highest annual average NO_2 concentration over five modeled years, the 8th-highest daily maximum concentration averaged over 5 years at each receptor.

[3] The 2009-2011 background concentrations for each criteria pollutant were obtained through the NW AIRQUEST website (http://lar.wsu.edu/nw-airquest/lookup.html) for latitude = 48.016623, longitude = -122.194826.

[4] Total concentration is the sum of the design concentration and the background concentration.

[5] The recently adopted WAC 173-476 aligns the Washington Ambient Air Quality Standards (WAAQS) with the National Ambient Air Quality Standards (NAAQS) for NO_2.

5.12 Conclusions

The AERMOD modeling methodology described above predicts that emissions attributable to the proposed project will not cause or contribute to an exceedance of any ambient standards. Because no toxic air pollutants exceed the first tier screening levels in WAC 173-460-150, a second tier review is not needed to determine compliance for these emissions.

APPENDIX A: PSCAA NOC FORMS

AGENCY USE ONLY	NOC#:	REG#:	Date Fee Pd:	Eng. Assigned:
	11665	30196	9/5/18	

pscleanair.org
Puget Sound Clean Air Agency

Puget Sound Clean Air Agency
1904 Third Avenue, Suite 105 | Seattle, WA 98101-3317
Phone 206-343-8800 | 206-343-7522 Fax

Need assistance? Free translation services available at 206-343-8800
Español 中文 Tiếng Việt 한국어 Tagalog русский

NOTICE OF CONSTRUCTION APPLICATION FOR ORDER OF APPROVAL

The following information must be submitted as part of this application packet before an Agency engineer is assigned to review your project.

SECTION 1. FACILITY INFORMATION

Business Name: Cadman Materials			
Equipment Installation Address: 17 E. Marine View Drive	City: Everett	State: WA	Zip: 98201
Is the business registered with the Agency at this equipment installation address? ☐ Yes. Current Registration or AOP No. _____ ☐ No, not registered ☒ Unknown			
Business Owner Name: Cadman Materials			
Business Mailing Address: 7554 185th Avenue NE, Suite 100	City: Redmond	State: WA	Zip: 98052
Type of Business: Soil Remediation			
NAICS Code: 562910	NAICS Description: Soil remediation services		
Contact Name (for this application): Christy McDonough	Phone: 425-961-7325	Email: Christy.McDonough@Lehi	
Provide a 1-2 sentence simple description of this project: Cadman Materials proposes to relocate the thermal desorption unit used to remediate contaminated soil from its Everett-Glenwood Facility to its Delta Site in North Everett.			

SECTION 2: REQUIRED APPLICATION PACKET ATTACHMENTS

1) **$1,150 filing fee** (nonrefundable)
   - ☐ PAY BY CHECK – Attached and made payable to **Puget Sound Clean Air Agency**
   - ☒ PAY BY CREDIT – Accounting technician will contact person identified below for payment information

Contact Name:	Contact Number:
Christy McDonough	425-961-7325

2) **Detailed Project Description**
   The project description must include a detailed description of the project, a list of process and control equipment to be installed or modified, a description of how the proposed project will impact your existing operations (if applicable), and measures that will be taken to minimize air emissions.

   Detailed description of the proposed project included in packet?
   ☒ YES, attached. ☐ NO, not attached. This application is incomplete.

NOTICE OF CONSTRUCTION APPLICATION FOR ORDER OF APPROVAL

SECTION 2: REQUIRED APPLICATION PACKET ATTACHMENTS (CONT)

3) **Process flow diagram**
☒ YES, attached. ☐ NO, not attached. This application is incomplete

4) **Emission estimate.** Emission rate increases for all pollutants.
☒ YES, attached. ☐ NO, not attached. This application is incomplete.

5) **Environmental Checklist** (or a determination made by another Agency under the State Environmental Policy Act)
www.pscleanair.org/DocumentCenter/View/170
☐ YES, attached. ☒ NO, not attached. This application is incomplete..

6) Attach **equipment form**(s) applicable to your operation. Forms are available online at
www.pscleanair.org/178/Apply-for-Notice-of-Construction-Permit
☒ YES, attached. ☐ NO, not attached. This application is incomplete.

SECTION 3: PROCESS AND CONTROL EQUIPMENT (attach additional pages if necessary)

Process Equipment		Does this equipment have air pollution control equipment?	Air Pollution Control Equipment	
# of Units	Equipment Type & Design Capacity		# of Units	Equipment Type
1	Thermal Desorption Unit (soil remediation)	☒ Yes ☐ No	1	Baghouse
		☐ Yes ☐ No	1	Afterburner (thermal oxidizer)
		☐ Yes ☐ No		

SECTION 4: CERTIFICATION STATEMENT

I, the undersigned, certify that the information contained in this application and the accompanying forms, plans, specifications, and supplemental data described herein is, to the best of my knowledge, accurate and complete.

Signature — 8/24/18 Date

Christy McDonough — Printed Name

Environment manager — Title

SECTION 5: APPLICATION SUBMITTAL

☒ **EMAIL application and attachments to:**
NOC@pscleanair.org

-OR-

☐ **MAIL application, payment, and attachments to:**
Puget Sound Clean Air Agency
ATTN: NOC Application Submittal
1904 3rd Ave, Suite 105 - Seattle, WA 98101

THIS SECTION FOR AGENCY USE ONLY						
Eng. Assigned (Compliance Mgr)	Eng. Rec'd (Eng)	Web description (Eng)	Completeness review (Eng)	Routed for OA Prep (Eng)	OA signed (Compliance Mgr)	OA mailed (Admin)
Date:	Date:	Date:	Date:	Date:	Date:	Date:

pscleanair.org
Puget Sound Clean Air Agency

PUGET SOUND CLEAN AIR AGENCY

1904 3rd Ave, Ste 105S
eattle WA 98101-3317

(206) 689-4052 Fax: (206) 343-7522 <www.pscleanair.org>

NOTICE OF CONSTRUCTION AND APPLICATION FOR APPROVAL

Incomplete applications delay Agency review, so please fill out your application thoroughly

Soil & Groundwater Remediation	**Form SGR**

AGENCY USE ONLY: DATE REG NO. NOC NO.

Facility Information

Facility Name as it appears on outside of building	Cadman Materials	
Site Address (incl. city, state, zip) 17 E. Marine View Drive, Everett, WA 98201		
Site Contact Larry Baker	Site Phone # 425-356-6619	Email larryw.baker@lehighhanson.com

Applicant/Invoicing Information

Company Cadman Materials	Applicant: Christy McDonough	
Phone # 425-961-7325	E-mail christy.mcdonough@lehighhanson.com	Fax #
Mailing Address (incl. city, state, zip) 7554 185th Avenue NE, Suite 100, Redmond, WA, 98052		

TYPE OF BUSINESS (Check one)	STATUS OF EQUIPMENT (Check one)
✠ NEW ❑ EXISTING	❑ NEW ❑ EXISTING ❑ ALTERED ✠ RELOCATION

PROCESS EQUIPMENT DESCRIPTION: **Thermal Desorption Unit for remediating contaminated soil**

NO. OF UNITS: 1 MAKE AND MODEL **Rotary burner is Hauck StarJet 200**

CONNECTED TO: **Baghouse (Maxim Stationary Baghouse Size 24/14.5) and Afterburner (Hauck StarJet 360)**

CONTROL EQUIPMENT (Must Meet 90% Destruction Efficiency):

_____ Vapor Carbon Vessels (Two in Series) _____ Catalytic Oxidizer ___X__Thermal Oxidizer
_____ Internal Combustion Engine __X___ Other(Specify) Baghouse Enclose a narrative that addresses procedures for continued proper operation and maintenance of selected control equipment (i.e., monitoring carbon bed exhaust for breakthrough, monitoring temperature of thermal oxidizer, etc.). **See NOC application.**

Planned Start Date for Construction **Q2, 2019** Planned Start Date for Operation **Q2, 2019**

GAS STREAM CHARACTERISTICS OF CONTROL EQUIPMENT

	Temperature(°F)	Static Pressure (psig)	Flow Rate(acfm)
INLET	1500F	36 osig	125,322
OUTLET	1500F	36 osig	125,322

AIR CONTAMINANT EMISSION WORST CASE ESTIMATE (Attach separate sheet with calculations)

POLLUTANT	UNCONTROLLED LB/DAY	UNCONTROLLED LB/YEAR	UNCONTROLLED LB/LIFETIME	CONTROL EFFICIENCY	CONTROLLED LBS/LIFETIME
VOC	**57,614**	**1.80E7**	**Unknown**	**75% in rotary dryer, 99.8% in Afterburner**	**1.25 lb/hr**
					4.70 tpy
					lifetime unknown
TOTAL PETROLEUM HYDROCARBONS:					

No more than 2% of 60 ton/hr soil load are hydrocarbons

AMOUNT OF SOIL TO BE REMEDIATED: **60 tons/hr**
FLOW RATE (gpm): _____
ESTIMATED DURATION OF PROJECT: **Unknown**

Days of Operation (Circle) S **M T W T F** S
Daily Hours of Operation **Continuous, up to 144 hrs/wk**
From _____ am to _____ pm

EXHAUST STACK PARAMETERS

Stack Height Above Ground (ft)	Stack Internal Diameter at Exit (ft)	CFM Exhausted	Velocity (ft/sec)
48	5.97	125,322 acfm	74.2

FLOW DIAGRAM & PLOT PLAN

FLOW DIAGRAM INSTRUCTIONS
(a) FLOW DIAGRAM MAY BE SCHEMATIC. ALL EQUIPMENT SHOULD BE SHOWN WITH EXISTING EQUIPMENT SO INDICATED.
(b) SHOW FLOW DIAGRAM OF PROCESS.
(c) INDICATE ALL POINTS IN PROCESS WHERE GASEOUS OR PARTICULATE POLLUTANTS ARE EMITTED.
(d) FLOW CHART CAN BE ATTACHED SEPARATELY IF NECESSARY. (DRAWINGS MAY BE SUBMITTED INSTEAD, IF DESIRED).
(e) ATTACH A PLOT PLAN SHOWING NEAREST PUBLIC ACCESS. **See attached flow diagram**

Certification

I, the undersigned, do hereby certify that the information contained in this application is, to the best of my knowledge, accurate and complete.

Signature | Date: 8-24-18

Larry Baker, Manager Soil Remediation | 425-356-6619

Type or Print Name and Title | Phone

Your application will not be processed unless you mail a $1,150 filing fee payment *along with the application*. Additional fees may apply after the application is reviewed. To pay by credit card, check here [X] and an accounting technician will contact you.

PUGET SOUND CLEAN AIR AGENCY

Additional Notice of Construction
Application Requirements for

THERMAL DESORPTION (SOIL REMEDIATION)

General

Description of Equipment and its Purpose *[Specify the type of thermal desorption equipment (rotary dryer or oven) and the reason for using it (remediation of soil on-site or from other sites)]* **Rotary dryer and Afterburner thermal oxidizer used to remediate soil from other sites.**

Identify which of the following categories the project fits into:

1. New Construction *(New construction also includes existing, unpermitted equipment or processes*). **This project would be considered new construction because the existing TDU is being relocated to a new location.**
2. Reconstruction *(Reconstruction means the replacement of components of an existing facility to such an extent that the fixed capital cost of the new components exceeds 50% of the fixed capital cost that would be required to construct a comparable entirely new facility)*
3. Modification *(Modification means any physical change in, or change in the method of operation of, a source, except an increase in the Hours of Operation or production rates (not otherwise prohibited) or the use of an alternative fuel or raw material that the source is approved to use under an Order of Approval or operating permit, that increases the amount of any air contaminant emitted or that results in the emission of any air contaminant not previously emitted)*
4. Amendment to Existing Order of Approval Permit Conditions

Estimated Hours of Operation (hr/day, day/wk, wk/yr) *[Estimate the hours of operation for the new thermal desorption equipment - not necessarily the entire facility.]* **144 hrs/week (7,509 hrs/yr)**

Estimated Installation Date *[Estimate the date when the new thermal desorption equipment will be put into service]* **Quarter 2, 2019**

Estimated Removal Date *[Estimate the date when the new thermal desorption equipment will be taken out of service]* **Unknown**

Contaminant Properties

Contaminants to be Vented *[Specify the chemicals to be vented from the soil]*
Please see Table 2-1, Table 2-2, and Table 2-4 (soil only) in NOC application.

Concentration of Each Contaminant (mg/l or ppm) *[Specify the initial (present) chemical concentration of each contaminant]* **Please see Tables 2-3, 2-5, 2-9 and section 2.2.3 in NOC application.**

Emission Estimates for Each Contaminant (total lb, maximum lb/yr) *[Estimate the total emission of each contaminant emitted during the course of the remediation (the mass of soil times the difference in concentration), and the maximum annual emissions].* **Please see Tables 2-1, 2-2, 2-4, 2-6, 2-7, 2-8, and 2-10 in NOC application.**

Design ***[Most design information is available from the manufacturer or vendor. Submittal of a brochure, scale drawing or process and instrumentation diagram will facilitate the review of the permit application]***

Make & Model *[Specify the manufacturer and model of the dryer or oven - not the serial number].* **Rotary Dryer: Hauck Starjet SJ200, Afterburner: Hauck Starjet SJ360. Both burners have 36 osig direct drive blowers.**

Rated Capacity (ton/hr) *[Specify the maximum amount of soil that can be processed per hour]* **60 ton/hr**

Estimated Annual Processing (ton/yr) *[Estimate the annual amount of soil to be processed]* **450,540 ton/yr**

Type of Fuel *[Specify natural gas, propane, #2 fuel oil, or other (be specific).]* **Natural gas**

Rated Heat Input (Million Btu/hr) *[Specify the rated heat input (the maximum fuel firing rate times the upper heating value of the fuel).]* **Rotary Dryer: 37 MBtu/hr , Afterburner: 70.4 MBtu/hr**

Estimated Annual Fuel Usage (Million cu ft/yr, thousand gal/yr) *[Estimate how many million cubic feet of gaseous fuel or thousands of gallons of liquid fuel will be burned annually. Alternatively, specify how many billion Btu/yr.].* **Rotary Dryer: 272 million cu ft NG /year, Afterburner: 518 million cu ft NG /year**

Stack ***[Required only for units without additional control equipment. Otherwise, use the appropriate permit forms for control equipment (thermal oxidizer, baghouse, absorber)]***

Stack Height (ft) *[Specify the height of the top of the stack above ground level - not above the building or sea level]*

Stack Diameter or Rectangular Cross-Sectional Dimensions (inches) *[Specify the internal dimensions - not the external dimensions]*

Exhaust Flowrate (acfm) *[Specify the airflow in actual cubic feet per minute]*

Exhaust Temperature (°F) *[Specify the temperature of the exhaust leaving the stack*]:
Distance to Nearest Property Line (ft) *[Specify the distance from the base of the stack to the nearest property line.]* **95 feet**

Height, Length and Width of Buildings (ft) *[Specify the approximate dimensions of any buildings that are >40% of the stack height and are located within 5 building heights from the stack.]*

Container 1 and Container 2: 40 feet high, 40 feet long, 8 feet wide ; Breakroom: 40 feet high, 60 feet long, 11.8 feet wide ; Scalehouse: 40 feet high, 100 feet long, 12 feet wide

Operation and Maintenance

Method Used to Monitor Emission Rates *[Specify the test method and frequency used to monitor the pollutant emission rate to the atmosphere.]. Opacity: Ecology method 9A, 3 minutes in a hour; Particulates: U.S EPA Method 5, average of 3 60-minute test runs; NMVOC: U.S. EPA methods 1,3A, 4, and 25A, average of 3 60-minute test runs, NOx: U.S. EPA methods 1, 3A, 4, 7E, average of 3 60-minute test runs, CO: U.S. EPA methods 1, 3A, 4, 10, average of 3 60-minute test runs.*

Describe Preventive Maintenance *[Specify the periodic maintenance recommended by the manufacturer and its frequency].***Maintenance issues will be addressed every 24-hour period the TDU not in operation.**

APPENDIX B: DETAILED EMISSION CALCULATIONS

Summary

Criteria Pollutants

VOC permit limit	PM10		PM2.5		VOC		SO2		NOX		CO		CH4		CO2		N2O	
	Hourly	Annual	Hourly	Annual	Hourly	Annual	Hourly	Annual	Hourly	Annual	Hourly	Annual	Hourly	Annual	Hourly	Annual	Hourly	Annual
0.021	*lb/hr*	*tpy*	*lb/hr*	*tpy*	*lb/hr*	*tpy*	*lb/hr*	*tpy*	*lb/hr*	*tpy*	*lb/hr*	*tpy*	*lb/hr*	*tpy*	*lb/hr*	*tpy*	*lb/hr*	*tpy*
lb NMVOC/ton	8.7	32.6	8.7	32.6	1.25	4.7	2.5	9.5	17.4	65.5	10.6	39.7	0.0	0.1	12635.3	47439.2	0.3	1.2
	g/s	*g/s*	*g/s*	*g/s*	*g/s*	*g/s*	*g/s*	*g/s*	*g/s*	*g/s*	*g/s*	*g/s*	*g/s*	*g/s*	*g/s*	*g/s*	*g/s*	*g/s*
	1.10E+00	9.39E-01	1.10E+00	9.39E-01	1.58E-01	1.35E-01	3.17E-01	2.72E-01	2.20E+00	1.88E+00	1.33E+00	1.14E+00	2.67E-03	2.29E-03	1.59E+03	1.36E+03	4.05E-02	3.47E-02

TAPS

			Emissions (lb/avg. period)								Modeling (g/s)				HAP Regulation Check	
CAS	Pollutants	Avg. Period	FuelOil	Rotary Dryer	After Burner	Total Emissions	De Minimis	Above De Minimis (Y/N)?	SQER	Above SQER Model (Y/N)	Fuel Oil	Rotary Dryer	After Burner	Sum	TPY	Notes:
630-08-0	CO	1-hr	1.73E+00	3.05E+00	5.80E+00	1.06E+01	1.14E+00	Y	5.04E+01	N	2.18E-01	3.84E-01	7.30E-01	1.33E+00	3.97E+01	
10102-44-0	NO2	1-hr	6.91E+00	3.63E+00	6.90E+00	1.74E+01	4.57E-01	Y	1.03E+00	Y	8.71E-01	4.57E-01	8.70E-01	2.20E+00	6.55E+01	
7446-09-05	SO2	1-hr	2.45E+00	2.18E-02	4.14E-02	2.52E+00	4.57E-01	Y	1.45E+00	Y	3.09E-01	2.74E-03	5.22E-03	3.17E-01	9.45E+00	
71-55-6	1,1,1-Trichloroethane	24-hr	1.96E-03	--	--	1.96E-03	6.57E+00	N	1.31E+02	N	1.03E-05	--	--	1.03E-05	3.06E-04	
56-49-5	3-Methylcholanthrene	year	--	4.90E-04	9.33E-04	1.42E-03	1.53E-03	N	3.05E-02	N	--	7.05E-09	1.34E-08	2.05E-08	--	Not HAP
57-97-6	7,12-Dimethylbenz (a)anthracene	year	--	4.36E-03	8.29E-03	1.27E-02	1.35E-04	Y	2.71E-03	Y	--	6.27E-08	1.19E-07	1.82E-07	--	Not HAP
7440-38-2	Arsenic	year	3.43E+00	5.45E-02	1.04E-01	3.58E+00	2.91E-03	Y	5.81E-02	Y	4.93E-05	7.83E-07	1.49E-06	5.15E-05	1.54E-03	
56-55-3	Benz(a)anthracene	year	1.04E-02	4.90E-04	9.33E-04	1.18E-02	8.72E-02	N	1.74E+00	N	1.50E-07	7.05E-09	1.34E-08	1.70E-07	--	Not HAP
71-43-2	Benzene	year	5.55E-01	5.72E-01	1.09E+00	2.22E+00	3.31E-01	Y	6.62E+00	N	7.99E-06	8.23E-06	1.57E-05	3.19E-05	9.50E-04	
50-32-8	Benzo(a)pyrene	year	--	3.27E-04	6.22E-04	9.49E-04	8.72E-03	N	1.74E-01	N	--	4.70E-09	8.94E-09	1.36E-08	--	Not HAP
205-99-2	Benzo(b,k) fluoranthene	year	3.84E-03	4.90E-04	9.33E-04	5.26E-03	8.72E-02	N	1.74E+00	N	5.52E-08	7.05E-09	1.34E-08	7.57E-08	--	Not HAP
7440-41-7	Beryllium	year	7.22E-02	3.27E-03	6.22E-03	8.16E-02	4.00E-03	Y	8.00E-02	Y	1.04E-06	4.70E-08	8.94E-08	1.17E-06	3.50E-05	
7440-43-9	Cadmium	year	1.03E+00	3.00E-01	5.70E-01	1.90E+00	2.28E-03	Y	4.57E-02	Y	1.49E-05	4.31E-06	8.20E-06	2.74E-05	8.16E-04	
18540-29-9	Chromium VI	year	6.44E-01	1.53E-02	2.90E-02	6.88E-01	6.40E-05	Y	1.28E-03	Y	9.26E-06	2.19E-07	4.17E-07	9.89E-06	2.95E-04	
218-01-9	Chrysene	year	6.18E-03	4.90E-04	9.33E-04	7.60E-03	8.72E-01	N	1.74E+01	N	8.88E-08	7.05E-09	1.34E-08	1.09E-07	--	Not HAP
7440-48-4	Cobalt	24-hr	4.99E-02	7.31E-05	1.39E-04	5.02E-02	6.57E-04	Y	1.30E-02	Y	2.62E-04	3.84E-07	7.30E-07	2.63E-04	7.85E-03	
7440-50-8	Copper	1-hr	6.08E-04	3.08E-05	5.87E-05	6.98E-04	1.10E-02	N	2.19E-01	N	7.67E-05	3.88E-06	7.39E-06	8.79E-05	--	Not HAP
53-70-3	Dibenzo(a,h) anthracene	year	4.33E-03	3.27E-04	6.22E-04	5.28E-03	7.99E-03	N	1.60E-01	N	6.23E-08	4.70E-09	8.94E-09	7.60E-08	--	Not HAP
100-41-4	Ethylbenzene	year	1.65E-01	--	--	1.65E-01	3.84E+00	N	7.68E+01	N	2.37E-06	--	--	2.37E-06	--	Not HAP
50-00-0	Formaldehyde	year	8.57E+01	2.04E+01	3.89E+01	1.45E+02	1.60E+00	Y	3.20E+01	Y	1.23E-03	2.94E-04	5.59E-04	2.08E-03	6.21E-02	
110-54-3	Hexane	24-hr	--	1.57E+00	2.98E+00	4.55E+00	4.60E+00	N	9.20E+01	N	--	8.23E-03	1.57E-02	2.39E-02	7.12E-01	
193-39-5	Indo(1,2,3-cd)pyrene	year	5.55E-03	4.90E-04	9.33E-04	6.98E-03	8.72E-02	N	1.74E+00	N	7.99E-08	7.05E-09	1.34E-08	1.00E-07	--	Not HAP
7439-92-1	Lead	year	3.92E+00	1.36E-01	2.59E-01	4.31E+00	1.00E+01	N	1.60E+01	N	5.64E-05	1.96E-06	3.73E-06	6.21E-05	1.85E-03	
7439-96-5	Manganese	24-hr	2.49E-02	3.31E-04	6.29E-04	2.58E-02	2.63E-04	Y	5.26E-03	Y	1.31E-04	1.74E-06	3.30E-06	1.36E-04	4.04E-03	
7439-97-6	Mercury	24-hr	9.37E-04	2.26E-04	4.31E-04	1.59E-03	5.91E-04	Y	1.18E-02	N	4.92E-06	1.19E-06	2.26E-06	8.37E-06	2.49E-04	
91-20-3	Naphthalene	year	2.93E+00	1.66E-01	3.16E-01	3.42E+00	2.82E-01	Y	5.64E+00	N	4.22E-05	2.39E-06	4.55E-06	4.91E-05	1.46E-03	
7723-14-0	Phosphorus	24-hr	7.85E-02	--	--	7.85E-02	1.31E-01	N	2.63E+00	N	4.12E-04	--	--	4.12E-04	1.23E-02	
7782-49-2	Selenium	24-hr	5.67E-03	2.09E-05	3.98E-05	5.73E-03	1.31E-01	N	2.63E+00	N	2.97E-05	1.10E-07	2.09E-07	3.01E-05	8.96E-04	
108-88-3	Toluene	24-hr	5.14E-02	2.96E-03	5.63E-03	6.00E-02	3.29E+01	N	6.57E+02	N	2.70E-04	1.55E-05	2.96E-05	3.15E-04	9.39E-03	
7440-62-2	Vanadium	24-hr	2.64E-01	2.00E-03	3.81E-03	2.70E-01	1.31E-03	Y	2.63E-02	Y	1.39E-03	1.05E-05	2.00E-05	1.42E-03	--	Not HAP
1330-20-7	o-Xylene	24-hr	9.04E-04	--	--	9.04E-04	1.45E+00	N	2.90E+01	N	4.75E-06	--	--	4.75E-06	1.41E-04	
7647-01-0	HCl	24-hr	2.22E+01	--	--	2.22E+01	5.91E-02	Y	1.18E+00	Y	1.16E-01	--	--	1.16E-01	3.47E+00	

Stack Parameters

Main Stack from Soil Incinerator

SRC ID	Type	UTM X	UTM Y	Elevation	Release Height	Temperature	Release Velocity	Diameter
SoilStck	POINT	560111.2	5318438	4	14.6297	1074.48	22.6343	1.8239

Temperature	1500	F	
Height	48	ft	
Flow	125322	acfm	59.13686 m3/s
Stack Area	2.61	m2	
Stack Diameter	71.81	in	

Emissions Associated with Fuel Oil in Contaminated Soil

Operating Hours	24	hr/day	
Operating Hours	144	hr/week	Permit
Operating Hours	7509	hr/year	
Throughput	60	ton/hr	
Contamination	2%	Hydrocarbon percentage	
Hydrocarbon Load	1.2	ton/hr	
Density of diesel	6.943	lb/gal	
Hydrocarbon Load	345.7	gal/hr	
Dryer VOC Destruction Efficiency	75%	Combustion during volitalization of VOCs	
AB VOC Destruction Efficiency	99.8%	Combustion in afterburner	
Percent VOCs Remaining	0.05%		
VOC Emissions	1.2	lb/hr	
	4.5	tpy	
Sulfur Content	0.05	From Iron Mountain Example (It is 0.05%, use '0.05' in AP-42 EF formulas)	
HCl Molecular Weight	36.46	g/mol	

Criteria Pollutants

	unit	Distillate	No. 6	Uncontrolled lb/hr	Controlled lb/hr	tpy	lb/day
VOC	--	--	--	2400.0	1.20E+00	4.51E+00	2.88E+01
SO2	lb/10^3 gal	7.1	7.85		2.45E+00	9.21E+00	5.89E+01
NOx	lb/10^3 gal	20	47		6.91E+00	2.60E+01	1.66E+02
CO	lb/10^3 gal	5	5		1.73E+00	6.49E+00	4.15E+01
TOC	lb/10^3 gal	0.556	1.605		9.61E-05	3.61E-04	2.31E-03
Methane	lb/10^3 gal	0.216	0.475		3.73E-05	1.40E-04	8.96E-04
NMTOC	lb/10^3 gal	0.34	1.13		5.88E-05	2.21E-04	1.41E-03
N2O	lb/10^3 gal	0.26	0.53		8.99E-02	3.37E-01	2.16E+00
POM	lb/10^3 gal	0.0033	0.0012		1.14E-03	4.28E-03	2.74E-02
CH2O	lb/10^3 gal	0.048	0.0425		8.30E-06	3.11E-05	1.99E-04
PM2.5	lb/10^3 gal	2	3.6795		6.91E-01	2.60E+00	1.66E+01
PM10	lb/10^3 gal	2	3.6795		6.91E-01	2.60E+00	1.66E+01

1) EFs from AP-42 1.3: Fuel Oil Combustion for "distillate oil fired" (distillate mentioned in Iron Mountain workbook)
2) https://www3.epa.gov/ttnchie1/ap42/ch01/final/c01s03.pdf
3) Assume PM2.5 and PM10 are equal
4) Commercial/institutional/residential combustor EF used for TOC, Methane, and NMTOC
5) POM mean of EF range used (0.0011-0.0013)
6) CH2O mean of EF range used (0.035-0.061 for distillate, 0.024-0.061 for No. 6)

Emissions Associated with Fuel Oil in Contaminated Soil

TAPS	CAS	Unit	EF	lbs/hr	lbs/day	lbs/year	tpy
CO	630-08-0	lb/10^3 gal	5	1.73E+00	4.15E+01	1.30E+04	6.49E+00
NO2	10102-44-0	lb/10^3 gal	20	6.91E+00	1.66E+02	5.19E+04	2.60E+01
SO2	7446-09-05	lb/10^3 gal	7.1	2.45E+00	5.89E+01	1.84E+04	9.21E+00
Acenaphthene	83-32-9	lb/10^3 gal	2.11E-05	7.29E-06	1.75E-04	5.48E-02	2.74E-05
Acenaphthylene	203-96-8	lb/10^3 gal	2.53E-07	8.75E-08	2.10E-06	6.57E-04	3.28E-07
Anthracene	120-12-7	lb/10^3 gal	1.22E-06	4.22E-07	1.01E-05	3.17E-03	1.58E-06
Antimony Trioxide	1309-64-4	lb/10^3 gal	5.25E-03	1.81E-03	4.36E-02	1.36E+01	6.81E-03
Arsenic	7440-38-2	lb/10^3 gal	1.32E-03	4.56E-04	1.10E-02	3.43E+00	1.71E-03
Barium	7440-39-3	lb/10^3 gal	2.57E-03	8.88E-04	2.13E-02	6.67E+00	3.34E-03
Benz(a)anthracene	56-55-3	lb/10^3 gal	4.01E-06	1.39E-06	3.33E-05	1.04E-02	5.20E-06
Benzene	71-43-2	lb/10^3 gal	2.14E-04	7.40E-05	1.78E-03	5.55E-01	2.78E-04
Benzo(b,k)fluoranthene	205-99-2	lb/10^3 gal	1.48E-06	5.12E-07	1.23E-05	3.84E-03	1.92E-06
Benzo(g,h,i)perylene	191-24-2	lb/10^3 gal	2.26E-06	7.81E-07	1.87E-05	5.87E-03	2.93E-06
Beryllium	7440-41-7	lb/10^3 gal	2.78E-05	9.61E-06	2.31E-04	7.22E-02	3.61E-05
Cadmium	7440-43-9	lb/10^3 gal	3.98E-04	1.38E-04	3.30E-03	1.03E+00	5.17E-04
Chloride	7782-50-5	lb/10^3 gal	3.47E-01	1.20E-01	2.88E+00	9.01E+02	4.50E-01
Chromium	--	lb/10^3 gal	8.45E-04	2.92E-04	7.01E-03	2.19E+00	1.10E-03
Chromium VI	18540-29-9	lb/10^3 gal	2.48E-04	8.57E-05	2.06E-03	6.44E-01	3.22E-04
Chrysene	218-01-9	lb/10^3 gal	2.38E-06	8.23E-07	1.97E-05	6.18E-03	3.09E-06
Cobalt	7440-48-4	lb/10^3 gal	6.02E-03	2.08E-03	4.99E-02	1.56E+01	7.81E-03
Copper	7440-50-8	lb/10^3 gal	1.76E-03	6.08E-04	1.46E-02	4.57E+00	2.28E-03
Dibenzo(a,h) anthracene	53-70-3	lb/10^3 gal	1.67E-06	5.77E-07	1.39E-05	4.33E-03	2.17E-06
Ethylbenzene	100-41-4	lb/10^3 gal	6.36E-05	2.20E-05	5.28E-04	1.65E-01	8.25E-05
Fluoranthene	206-44-0	lb/10^3 gal	4.84E-06	1.67E-06	4.02E-05	1.26E-02	6.28E-06
Fluorene	86-73-7	lb/10^3 gal	4.47E-06	1.55E-06	3.71E-05	1.16E-02	5.80E-06
Fluoride	--	lb/10^3 gal	3.73E-02	1.29E-02	3.09E-01	9.68E+01	4.84E-02
Formaldehyde	50-00-0	lb/10^3 gal	3.30E-02	1.14E-02	2.74E-01	8.57E+01	4.28E-02
Indo(1,2,3-cd)pyrene	193-39-5	lb/10^3 gal	2.14E-06	7.40E-07	1.78E-05	5.55E-03	2.78E-06
Lead	7439-92-1	lb/10^3 gal	1.51E-03	5.22E-04	1.25E-02	3.92E+00	1.96E-03
Manganese	7439-96-5	lb/10^3 gal	3.00E-03	1.04E-03	2.49E-02	7.79E+00	3.89E-03
Mercury	7439-97-6	lb/10^3 gal	1.13E-04	3.91E-05	9.37E-04	2.93E-01	1.47E-04
Molybedenum	7439-98-7	lb/10^3 gal	7.87E-04	2.72E-04	6.53E-03	2.04E+00	1.02E-03
Naphthalene	91-20-3	lb/10^3 gal	1.13E-03	3.91E-04	9.37E-03	2.93E+00	1.47E-03
Nickel	7440-02-0	lb/10^3 gal	8.45E-02	2.92E-02	7.01E-01	2.19E+02	1.10E-01
OCDD	--	lb/10^3 gal	3.10E-09	1.07E-09	2.57E-08	8.05E-06	4.02E-09
Phenanthrene	85-01-8	lb/10^3 gal	1.05E-05	3.63E-06	8.71E-05	2.73E-02	1.36E-05
Phosphorus	7723-14-0	lb/10^3 gal	9.46E-03	3.27E-03	7.85E-02	2.46E+01	1.23E-02
Pyrene	129-00-0	lb/10^3 gal	4.25E-06	1.47E-06	3.53E-05	1.10E-02	5.52E-06
Selenium	7782-49-2	lb/10^3 gal	6.83E-04	2.36E-04	5.67E-03	1.77E+00	8.86E-04
1,1,1-Trichloroethane	71-55-6	lb/10^3 gal	2.36E-04	8.16E-05	1.96E-03	6.13E-01	3.06E-04
Toluene	108-88-3	lb/10^3 gal	6.20E-03	2.14E-03	5.14E-02	1.61E+01	8.05E-03
Vanadium	7440-62-2	lb/10^3 gal	3.18E-02	1.10E-02	2.64E-01	8.25E+01	4.13E-02
o-Xylene	1330-20-7	lb/10^3 gal	1.09E-04	3.77E-05	9.04E-04	2.83E-01	1.41E-04
Zinc	7440-66-6	lb/10^3 gal	2.91E-02	1.01E-02	2.41E-01	7.55E+01	3.78E-02
HCl	7647-01-0	--	--	9.24E-01	2.22E+01	6.94E+03	3.47E+00

Burner Emissions for both Rotary Dryer and Afterburner

Operating Hours	24	hr/day	
Operating Hours	144	hr/week	Permit
Operating Hours	7509	hr/year	

Heating Requirements		
NG Heat Content	1020	BTU/ft3
Rotary Dryer	37	MBTU/hr
	36275	ft3 NG/hr
Rotary Dryer (Annual Total)	272	million ft3 NG/yr
Afterburner	70.4	MBTU/hr
	69020	ft3 NG/hr
Afterburner (Annual Total)	518	million ft3 NG/yr
Total	105294	ft3 NG/hr
Annual Total (million ft3/yr)	791	million ft3 NG/yr
Rotary dryer VOC control	75%	From Iron Mountain NOC application
Afterburner VOC control	99.8%	From Iron Mountain NOC application

EFs from AP-42 1.4: Natural Gas, <100 MMBTU Uncontrolled Small Boiler
https://www3.epa.gov/ttnchie1/ap42/ch01/final/c01s04.pdf

Note: PM not included, since it should be included in baghouse effluent

Criteria Pollutants and Greenhouse Gases										
AP-42 EF	NOx	CO	SO2	VOC	Methane	PM10	PM2.5	CO2	N2O	TOC
units: lb/10^6 scf	1.00E+02	8.40E+01	6.00E-01	5.50E+00	2.30E+00	7.60E+00	7.60E+00	1.20E+05	2.20E+00	1.10E+01
Rotary Dryer										
Hourly Emiss (lb/hr)	3.63E+00	3.05E+00	2.18E-02	4.99E-02	2.09E-02	2.76E-01	2.76E-01	4.35E+03	7.98E-02	9.98E-02
Daily Emiss (lb/day)	8.71E+01	7.31E+01	5.22E-01	1.20E+00	5.01E-01	6.62E+00	6.62E+00	1.04E+05	1.92E+00	2.39E+00
Annual Emiss (lb/year)	3.18E+04	2.67E+04	1.91E+02	4.37E+02	1.83E+02	2.42E+03	2.42E+03	3.81E+07	6.99E+02	8.74E+02
Annual Emiss (tpy)	1.36E+01	1.14E+01	8.17E-02	1.87E-01	7.83E-02	1.04E+00	1.04E+00	1.63E+04	3.00E-01	3.75E-01
Afterbuner										
Hourly Emiss (lb/hr)	6.90E+00	5.80E+00	4.14E-02	7.59E-04	3.17E-04	5.25E-01	5.25E-01	8.28E+03	1.52E-01	1.52E-03
Daily Emiss (lb/day)	1.66E+02	1.39E+02	9.94E-01	1.82E-02	7.62E-03	1.26E+01	1.26E+01	1.99E+05	3.64E+00	3.64E-02
Annual Emiss (lb/year)	6.05E+04	5.08E+04	3.63E+02	6.65E+00	2.78E+00	4.60E+03	4.60E+03	7.26E+07	1.33E+03	1.33E+01
Annual Emiss (tpy)	2.59E+01	2.18E+01	1.55E-01	2.85E-03	1.19E-03	1.97E+00	1.97E+00	3.11E+04	5.70E-01	5.70E-03

VOC uncontrolled (lb/hr)	
	5.50E+00
Rotary Dryer	
	2.00E-01
Afterburner	
	3.80E-01

Burner Emissions for both Rotary Dryer and Afterburner

		units: lb/10^6 scf
TAPS	CAS	AP-42 EF
CO	630-08-0	84
NO2	10102-44-0	100
SO2	7446-09-05	0.6
Lead	7439-92-1	5.00E-04
2-Methylnaphthalene	91-57-6	2.40E-05
3-Methylcholanthrene	56-49-5	1.80E-06
7,12-Dimethylbenz(a)anthracene	57-97-6	1.60E-05
Acenaphthene	83-32-9	1.80E-06
Acenaphthylene	203-96-8	1.80E-06
Anthracene	120-12-7	2.40E-06
Arsenic	7440-38-2	2.00E-04
Barium	7440-39-3	4.40E-03
Benz(a)anthracene	56-55-3	1.80E-06
Benzene	71-43-2	2.10E-03
Benzo(a)pyrene	50-32-8	1.20E-06
Benzo(b,k)fluoranthene	205-99-2	1.80E-06
Benzo(g,h,i)perylene	191-24-2	1.20E-06
Beryllium	7440-41-7	1.20E-05
Butane	106-97-8	2.10E+00
Cadmium	7440-43-9	1.10E-03
Chromium, (hexavalent)	18540-29-9	5.60E-05
Chrysene	218-01-9	1.80E-06
Cobalt	7440-48-4	8.40E-05
Copper	7440-50-8	8.50E-04
Dibenzo(a,h)anthracene	53-70-3	1.20E-06
Dichlorobenzene	25321-22-6	1.30E-03
Ethane	74-84-0	3.10E+00
Fluoranthene	206-44-0	3.00E-06
Fluorene	86-73-7	2.80E-06
Formaldehyde	50-00-0	7.50E-02
Hexane	110-54-3	1.80E+00
Indeno(1,2,3-cd)pyrene	193-39-5	1.80E-06
Manganese	7439-96-5	3.80E-04
Mercury	7439-97-6	2.60E-04
Molybdeum	7439-98-7	1.10E-03
Naphthalene	91-20-3	6.10E-04
Nickel	7440-02-0	2.10E-03
Pentane	109-66-0	2.60E+00
Phenanathrene	85-01-8	1.70E-05
Propane	74-98-6	1.60E+00
Pyrene	129-00-0	5.00E-06
Selenium	7782-49-2	2.40E-05
Toluene	108-88-3	3.40E-03
Vanadium	7440-62-2	2.30E-03
Zinc	7440-66-6	2.90E-02

Note: AP-42 Efs have units of lb/10^6 scf

Rotary Dryer			
lb/hr	lb/day	lb/year	tpy
3.05E+00	7.31E+01	2.29E+04	1.14E+01
3.63E+00	8.71E+01	2.72E+04	1.36E+01
2.18E-02	5.22E-01	1.63E+02	8.17E-02
1.81E-05	4.35E-04	1.36E-01	6.81E-05
8.71E-07	2.09E-05	6.54E-03	3.27E-06
6.53E-08	1.57E-06	4.90E-04	2.45E-07
5.80E-07	1.39E-05	4.36E-03	2.18E-06
6.53E-08	1.57E-06	4.90E-04	2.45E-07
6.53E-08	1.57E-06	4.90E-04	2.45E-07
8.71E-08	2.09E-06	6.54E-04	3.27E-07
7.25E-06	1.74E-04	5.45E-02	2.72E-05
1.60E-04	3.83E-03	1.20E+00	5.99E-04
6.53E-08	1.57E-06	4.90E-04	2.45E-07
7.62E-05	1.83E-03	5.72E-01	2.86E-04
4.35E-08	1.04E-06	3.27E-04	1.63E-07
6.53E-08	1.57E-06	4.90E-04	2.45E-07
4.35E-08	1.04E-06	3.27E-04	1.63E-07
4.35E-07	1.04E-05	3.27E-03	1.63E-06
7.62E-02	1.83E+00	5.72E+02	2.86E-01
3.99E-05	9.58E-04	3.00E-01	1.50E-04
2.03E-06	4.88E-05	1.53E-02	7.63E-06
6.53E-08	1.57E-06	4.90E-04	2.45E-07
3.05E-06	7.31E-05	2.29E-02	1.14E-05
3.08E-05	7.40E-04	2.32E-01	1.16E-04
4.35E-08	1.04E-06	3.27E-04	1.63E-07
4.72E-05	1.13E-03	3.54E-01	1.77E-04
1.12E-01	2.70E+00	8.44E+02	4.22E-01
1.09E-07	2.61E-06	8.17E-04	4.09E-07
1.02E-07	2.44E-06	7.63E-04	3.81E-07
2.72E-03	6.53E-02	2.04E+01	1.02E-02
6.53E-02	1.57E+00	4.90E+02	2.45E-01
6.53E-08	1.57E-06	4.90E-04	2.45E-07
1.38E-05	3.31E-04	1.04E-01	5.18E-05
9.43E-06	2.26E-04	7.08E-02	3.54E-05
3.99E-05	9.58E-04	3.00E-01	1.50E-04
2.21E-05	5.31E-04	1.66E-01	8.31E-05
7.62E-05	1.83E-03	5.72E-01	2.86E-04
9.43E-02	2.26E+00	7.08E+02	3.54E-01
6.17E-07	1.48E-05	4.63E-03	2.32E-06
5.80E-02	1.39E+00	4.36E+02	2.18E-01
1.81E-07	4.35E-06	1.36E-03	6.81E-07
8.71E-07	2.09E-05	6.54E-03	3.27E-06
1.23E-04	2.96E-03	9.26E-01	4.63E-04
8.34E-05	2.00E-03	6.26E-01	3.13E-04
1.05E-03	2.52E-02	7.90E+00	3.95E-03

Afterburner			
lb/hr	lb/day	lb/year	tpy
5.80E+00	1.39E+02	4.35E+04	2.18E+01
6.90E+00	1.66E+02	5.18E+04	2.59E+01
4.14E-02	9.94E-01	3.11E+02	1.55E-01
3.45E-05	8.28E-04	2.59E-01	1.30E-04
1.66E-06	3.98E-05	1.24E-02	6.22E-06
1.24E-07	2.98E-06	9.33E-04	4.66E-07
1.10E-06	2.65E-05	8.29E-03	4.15E-06
1.24E-07	2.98E-06	9.33E-04	4.66E-07
1.24E-07	2.98E-06	9.33E-04	4.66E-07
1.66E-07	3.98E-06	1.24E-03	6.22E-07
1.38E-05	3.31E-04	1.04E-01	5.18E-05
3.04E-04	7.29E-03	2.28E+00	1.14E-03
1.24E-07	2.98E-06	9.33E-04	4.66E-07
1.45E-04	3.48E-03	1.09E+00	5.44E-04
8.28E-08	1.99E-06	6.22E-04	3.11E-07
1.24E-07	2.98E-06	9.33E-04	4.66E-07
8.28E-08	1.99E-06	6.22E-04	3.11E-07
8.28E-07	1.99E-05	6.22E-03	3.11E-06
1.45E-01	3.48E+00	1.09E+03	5.44E-01
7.59E-05	1.82E-03	5.70E-01	2.85E-04
3.87E-06	9.28E-05	2.90E-02	1.45E-05
1.24E-07	2.98E-06	9.33E-04	4.66E-07
5.80E-06	1.39E-04	4.35E-02	2.18E-05
5.87E-05	1.41E-03	4.41E-01	2.20E-04
8.28E-08	1.99E-06	6.22E-04	3.11E-07
8.97E-05	2.15E-03	6.74E-01	3.37E-04
2.14E-01	5.14E+00	1.61E+03	8.03E-01
2.07E-07	4.97E-06	1.55E-03	7.77E-07
1.93E-07	4.64E-06	1.45E-03	7.26E-07
5.18E-03	1.24E-01	3.89E+01	1.94E-02
1.24E-01	2.98E+00	9.33E+02	4.66E-01
1.24E-07	2.98E-06	9.33E-04	4.66E-07
2.62E-05	6.29E-04	1.97E-01	9.85E-05
1.79E-05	4.31E-04	1.35E-01	6.74E-05
7.59E-05	1.82E-03	5.70E-01	2.85E-04
4.21E-05	1.01E-03	3.16E-01	1.58E-04
1.45E-04	3.48E-03	1.09E+00	5.44E-04
1.79E-01	4.31E+00	1.35E+03	6.74E-01
1.17E-06	2.82E-05	8.81E-03	4.41E-06
1.10E-01	2.65E+00	8.29E+02	4.15E-01
3.45E-07	8.28E-06	2.59E-03	1.30E-06
1.66E-06	3.98E-05	1.24E-02	6.22E-06
2.35E-04	5.63E-03	1.76E+00	8.81E-04
1.59E-04	3.81E-03	1.19E+00	5.96E-04
2.00E-03	4.80E-02	1.50E+01	7.51E-03

Baghouse Emissions

Operating Hours	24	hr/day	
Operating Hours	144	hr/week	Permit
Operating Hours	7509	hr/year	
Baghouse efficiency	0.997	Baghouse spec sheet (but don't use for calcs)	
PM			Source
Total PM Loading:	0.02	gr/dscf	Permit, assume all PM is PM2.5. PM10 = PM25
PM10 Loading	0.02		
PM2.5 Loading	0.02	gr/dscf	Assume 35% of total PM10 is PM2.5
Dry flow:	42,000	CFM	Baghouse spec sheet
Grain/lb	7000		

PM10		
Hourly PM10 Emissions	7.20E+00	lb/hr
Daily PM10 Emissions	1.73E+02	lb/day
Annual PM10 Emissions (lb/yr)	5.41E+04	lb/yr
Annual PM10 Emissions	2.70E+01	tpy
PM25		
Hourly PM25 Emissions	7.20E+00	lb/hr
Daily PM25 Emissions	1.73E+02	lb/day
Annual PM25 Emissions (lb/yr)	5.41E+04	lb/yr
Annual PM25 Emissions	2.70E+01	tpy

Fugitive PM emissions for screener, rotary drum feeder, and conveyor belt that transports remediated soil to trucks

Note: trucks will be traveling on paved surfaces so we do not estimate emissions from truck transit

Continous Drop Emission factors are estimated using methodology in AP-42 Section 13.2.4. [$E = k * 0.0032 * (U/5)^{1.3} / (M/2)^{1.4}$]
EPA. 2006. AP-42 Section 13.2.4. Aggregated Handling and Storage Piles. Available online at: https://www3.epa.gov/ttn/chief/ap42/ch13/final/c13s0204.pdf

Soil Throughput	60	tons/hr	
Operating Hours	24	hr/day	
Operating Hours	144	hr/week	Permit
Operating Hours	7509	hr/year	

Assumptions:	
Aerodynamic particle size multiplier (k):	
PM10	0.35
PM25	0.053
Material Moisture Content (%)	14
Wind Speed (mph)	7.6

Fugitive Emission Factors (lb/ton):	PM10	PM25
Screener (controlled), AP-42 11.19.2	7.40E-04	1.11E-04
Rotary drum feeder	1.27E-04	1.92E-05
Conveyor belt	1.27E-04	1.92E-05

Notes:
1. Use mean moisture content of clay/dirt mix from Table 13.2.4-1
2. Use 5-year average KPAE windspeed (3.4 m/s converted to mph)
3. Use controlled screener emission factor, which assumes some emission compression due to presence of some moisture (at least 2.88%).
4. Site operator mentioned that soil is often wet and the AP-42 clay/dirt moisture content (Table 13.2.4-1) is much higher than 2.88%
5. Assume PM25 is 15% of PM10 for screener emission factor, based on AP-42 Appendix B.2. Category 3

References:
EPA. 2006. AP-42 Section 13.2.4. Aggregated Handling and Storage Piles. Available online at: https://www3.epa.gov/ttn/chief/ap42/ch13/final/c13s0204.pdf
EPA. 2004. AP-42 Section 11.19.2. Crushed Stone Processing and Pulverized Mineral Processing: https://www3.epa.gov/ttnchie1/ap42/ch11/final/c11s1902.pdf

Fugitive Emissions	PM10				PM25			
	lb/hr	lb/day	lb/year	tpy	lb/hr	lb/day	lb/year	tpy
Screener (controlled), AP-42 11.19.2	4.44E-02	1.07E+00	3.33E+02	1.67E-01	6.66E-03	1.60E-01	5.00E+01	2.50E-02
Rotary drum feeder	7.60E-03	1.82E-01	5.70E+01	2.85E-02	1.15E-03	2.76E-02	8.64E+00	4.32E-03
Conveyor belt	7.60E-03	1.82E-01	5.70E+01	2.85E-02	1.15E-03	2.76E-02	8.64E+00	4.32E-03
Fugitive Sum	5.96E-02	1.43E+00	4.47E+02	2.24E-01	8.96E-03	2.15E-01	6.73E+01	3.36E-02

Notes:
1. Screener, rotary drum feeder, conveyor belt will be enclosed under roof with rest of TDU

Caculating ACFM and SCFM for Burners

Temperature (K)	298	* assumed standard condition
Pressure (psi)	14.69	

Standard Conditions from Air Pollution Control A design approach, by C. David Cooper

Legend	
	Input Value
	Constants

From SCFM to ACFM

Model	SCFM	Actual Temp (F)	Actual Temp (K)	Actual Pressure (osig)	Actual Pressure (psi)	ACFM Temp	ACFM Pressure
Rotary Drum SJ200	2800	550	560.928	37	2.3125	5270	33480
Afterburner SJ360	5400	1500	1088.706	37	2.3125	19728	125322

Note: Use ACFM with both temperature and pressure change applied

$$Q_{acfm} = Q_{scfm}\left(\frac{P_{scfm}}{P_{acfm}}\right)\left(\frac{T_{acfm}}{T_{scfm}}\right)$$

APPENDIX C: TECHNICAL SPECIFICATIONS DATA SHEET AND CURRENT TDU PERMIT

SALEM BLACKTOP

SALEM, OR

BAGHOUSE SPECIFICATIONS

1. Manufacturer: MAXAM EQUIPMENT, INC.
2. Model: MAXAM STATIONARY BAGHOUSE SIZE 24/14.5
3. CFM Capacity: MAXIMUM 42,000 @ 5.27:1 AIR TO CLOTH RATIO
4. Operating Inches W.G. (Pressure Drop) 3 - 6" W.G.
5. Number of Compartments in unit: ONE - FILTER BAG COMPARTMENT
6. Number of filter elements: 336
7. Size of Each Filter: 6 1/4" DIAMETER x 174" LONG
8. Type of Filter Material: 14 oz/sq yd Aramid Fiber
9. Maximum Recommended Operating Temperature: 350 DEGREES FAHRENHEIT
10. Total Effective Cloth Area: 7,972 SQUARE FEET
11. Cleaning Mechanism: PULSE JET
12. Estimated Time Between Cleaning Phases: 15 - 20 SECONDS
13. Number of Filter Elements Cleaned At One Time: 14
14. Particulate Collected: AGGREGATE DUST
15. Rated Efficiency: 99.7% Based on 80% Particulate above 5 Micron
16. Fan Stack is 42" dia. and overall height is 35'-0"

MAXAM™

Maxam Equipment, Inc.

1-800-292-6070

One 60 TPH Thermal Desorption Unit including a 60 ton/hr Rotary Dryer with two Burners rated at 37 MBtu/hr and 70.4 MBtu/hr, controlled by a Baghouse rated at 42,000 cfm and an Afterburner rated at 30,000 cfm (1500 degrees F).

APPLICANT

D J Mosier
CSR Associated
PO Box 2037
Everett, WA 98203

OWNER

CSR Associated
PO Box 2037
Everett, WA 98203

INSTALLATION ADDRESS

CSR Associated (Glenwood Plant #1), 6300 Glenwood Ave, Everett, WA, 98203

THIS ORDER IS ISSUED SUBJECT TO THE FOLLOWING RESTRICTIONS AND CONDITIONS

1. Approval is hereby granted as provided in Article 6 of Regulation I of the Puget Sound Clean Air Agency to the applicant to install or establish the equipment, device or process described hereon at the INSTALLATION ADDRESS in accordance with the plans and specifications on file in the Engineering Division of the Puget Sound Clean Air Agency.

2. This approval does not relieve the applicant or owner of any requirement of any other governmental agency.

3. The soil processed in the Thermal Desorption Unit (TDU) shall not exceed 2% petroleum hydrocarbon by weight (20, 000 ppm, petroleum-contaminated soil only).

4. No contaminated soil shall enter the TDU unless the temperature in the thermal oxidizer is maintained above 1400 degrees F. A temperature probe with an accuracy of 50 degrees F shall be installed and calibrated annually. This temperature probe shall be available for read-out by Puget Sound Clean Air Agency personnel upon request.

5. Opacity from the exhaust stack shall not exceed 10% for more than an aggregate of three minutes in any hour.

6. The particulate emissions from the exhaust stack shall not exceed 0.02 grains/dry standard cubic foot.

7. The burners used to heat the oxidizer shall only burn propane or natural gas. The burner used to heat the soil dryer may burn low sulfur diesel oil, provided the sulfur content of the diesel does not exceed 500 ppm sulfur and that the total diesel use does not exceed 375,000 gallons in any consecutive 12-month period.

8. The non-methane volatile organic compound emissions shall not exceed one pound per hour.

9. CSR Associated shall not operate the TDU for more than 144 hours/week. A log of the weekly hours of operation shall be kept and made available to Agency personnel upon request.

10. CSR Associated shall maintain documentation from the diesel fuel vendor concerning the sulfur content of the diesel fuel used to heat the soil dryer, and shall maintain a log of the amount of diesel fuel used to heat the dryer. This documentation and log shall be made available to Agency personnel upon request.

condensable particulate), and compliance with the opacity standard in Condition No. 5. Source testing must occur while processing petroleum contaminated soils at the maximum hourly rate, and while using diesel oil to heat the soil dryer. Source test results shall be submitted to the Agency within 60 days of the test.

12. This Order of Approval No. 8408, issued to replace the baghouse and allow for the use of low sulfur diesel oil to heat the soil dryer, hereby supersedes and cancels Order of Approval No. 5469 dated Jul 7, 1994.

APPEAL RIGHTS

Pursuant to Puget Sound Clean Air Agency's Regulation I, Section 3.17 and RCW 43.21B.310, this Order may be appealed to the Pollution Control Hearings Board (PCHB). To appeal to the PCHB, a written notice of appeal must be filed with the PCHB and a copy served upon Puget Sound Clean Air Agency within 30 days of the date the applicant receives this Order.

Agata McIntyre
Reviewing Engineer
mej

Steven Van Slyke
Reviewing Engineer

Dennis J. McLerran
Air Pollution Control Officer

APPENDIX D: AIR DISPERSION MODELING FILES (ONE DRIVE DIRECTORY)